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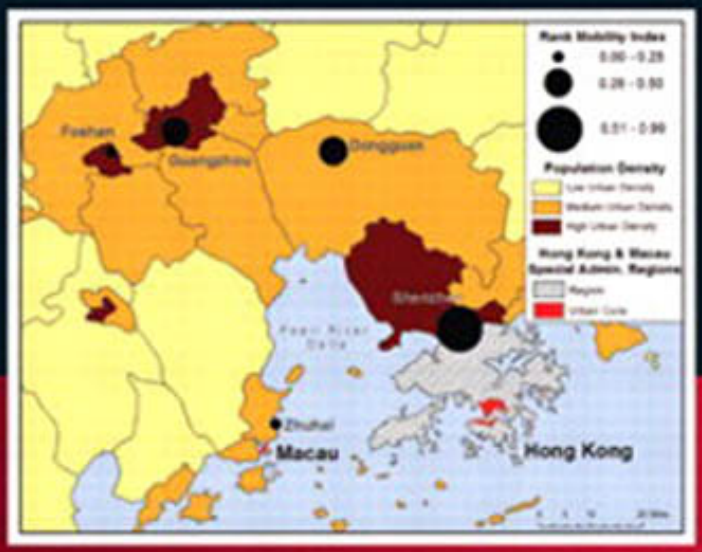
A GIS Approach

Second Edition



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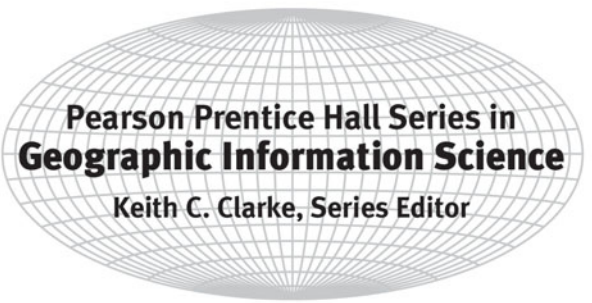

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A GIS Approach

Richard P. Greene
Northern Illinois University

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PREFACE

The second edition of *Exploring the Urban Community: A GIS Approach* remains grounded in the spatial analysis tradition of urban geography, with geographic information systems (GIS) as the principal tool for analysis. This book covers the traditional content of urban geography updated to contemporary literature and data as well as newer topics. The major topical areas are city dynamics, metropolitan concepts, city internal structure, systems of cities, land use, neighborhoods, urban migration and mobility, race, ethnicity, gender, poverty, industrial location, the edge cities and urban sprawl, housing, urban environmental change, technology, urban and regional planning, and global cities. Each chapter includes segments on concepts and theories, applications, examples and cases, and exercises.

Topics of recent interest in urban geography such as global cities, mega-regions, activism, China's urbanization, sexuality, climate change, urban policies of the Obama Administration, transnationalism, impact cities of the economic and housing crises of 2007–2010, internet and the city, and others enrich the study of the subject and complement as well as strengthen the traditional concepts and content. The book bridges these content areas and incorporates urban geography methods, GIS techniques, and spatial analysis to interpret spatial patterns and trends within urban areas.

The combination of the book's hands-on GIS approach to the study of the city and the substantive material of urban geography will enhance students' analytical skills, improve their job readiness, and prepare them to understand the changing urban world of this century.

NEW TO THIS EDITION

Major new features have been added to the second edition, and the content and underlying information are updated to the beginning of the 21st century's second decade. Students are stimulated and excited about the concepts and ideas of urban geography through hands-on exploration with Google Earth™ and/or ArcGIS. The new features include:

- **Class-tested Google Earth™ Exercises.** Google Earth™ exercises at the end of each chapter stimulate active learning among the students and open up visual avenues not achieved by the GIS exercises alone. The student or instructor can download Google Earth™ at no cost and click on the exercise files, which are written in Google Earth's .kmz macro language. This open approach makes the book more accessible to a wider audience and augments the use of the book by earlier adopters who want to liven up urban geography with visual web-based mapping either by itself or to complement ArcGIS software. In a Google Earth exercise, a student can experience cities at the neighborhood or street level and learn by exploring and discovering city features "on the ground." Each chapter exercise has both a Google Earth™ version and an ArcGIS version that are complementary to each other. The ArcGIS exercises continue to extend GIS functionality to those who want to emphasize a more complete tool set.
- **ArcGIS Exercises.** ArcGIS 10 has been utilized for all of the book's chapters allowing for software currency and the continuation of the "hands-on" approach that made the first edition so popular. They are updated with new content such as China's urban hierarchy. In addition, all of the GIS exercises in the older version ArcGIS 9.3.1 are available and downloadable from the book's premium website, allowing a seamless transition.
- **Analyzing an Urban Issue** chapter sections are integrated with the Google Earth and ArcGIS exercises. The GIS exercises have been proven to bring to the forefront important urban study issues developed in each of the chapters, and even stimulate further research initiatives with ready-made GIS problem solving the instructor can introduce for nearby urban areas in which the students can engage and learn. We discovered from the first edition that faculty and students were able to bridge methodology and data for urban areas we selected to their own urban areas, and accessing these nearby "urban laboratories" become even more widely possible with Google Earth features.

- The book is updated with **recent theory, current events, and the latest examples.** Updates to the urban environment chapter incorporate recent research and debates with respect to global environmental processes and human impacts, as well as environmental justice concerns. Sections are added or updated on The U.S. Gulf Oil Spill disaster, the U.S. housing crisis of 2007–2010, Hurricane Katrina and New Orleans, 2000s immigration of Hispanics and Asians to the U.S., climate change and cities, and renewable energy. New cases demonstrate political will and leadership in urban planning, while New Google Earth™ and ArcGIS exercises on air pollution and asthma in Chicago ask students to use data and maps to confront issues in health and environmental justice and encourage scrutiny of the strengths and weaknesses in the underlying data models. In the final chapter, new technology coverage includes internet and the city, mobile spatial connectivity, and the urban digital divide. The concepts of viable downtown and the urban policies of the Obama Administration are introduced and should stimulate discussion. Throughout, updated maps and new photos are included to engage the reader.
- **Expanded, in-depth international coverage in the Second Edition** provides a more global perspective, with discussion of a broader set of international regions and cities, leveraging the latest applications from today's headlines. We have expanded the international content throughout the book with new examples from China, India, Japan, and Africa, while retaining first edition examples of Mexico. For instance, Tokyo and Beijing are highlighted in discussions of urban definition and form. New sections define the metropolis, mega-regions, and Chinese and Indian global cities, including profiles of Tokyo, Beijing, Shanghai, and Mumbai.

  Since China's urbanization will possibly be the greatest urban movement in history, a new exercise focuses on China's urban system. In the developing world, planning problems and prospects for Johannesburg, South Africa, are examined, while the role of GIS during the 2010 Haiti earthquake is profiled.
- The **text's premium website** hosts Google Earth™ and ArcGIS files, and also includes web links, flashcards, quizzes, images, and PowerPoints®. Some of the artwork, maps, and photos, which were well received in first edition, have been updated or replaced with exciting and current new ones. PowerPoint® slides are downloadable from the book's premium website (http://www.mygeoscienceplace.com) and available to instructors and students.

The intent of the second edition changes is to provide a more current, accessible, and stimulating textbook, while retaining much of the content and features that were useful for learning in the first edition. It is the hope of the authors that students and professors will find this book contemporary, readable, informative, and knowledgeable; hands-on with spatial problems; and inclusive of the wide range of the body of knowledge and concerns of urban geography.

ACKNOWLEDGMENTS

This second edition would not have been possible without the support and assistance of many individuals. The authors are indebted to those persons, only some of whom are mentioned here, as well as to persons who supported the first edition.

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Dr. Greene's research interests focus on urban regeneration, edge cities, and land conversion processes on the urban-rural fringe, with expertise on Chicago, Los Angeles, and China's urban system. He conducts applied GIS research with regional and local governments in the Chicago metropolitan area, and he developed a GIS system for evaluating the loss of prime farmland to urbanization for the *American Farmland Trust*.

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Dr. Pick's awards include three Outstanding Faculty Research Awards from the University of Redlands, Outstanding Alumni Award of College of Liberal Arts and Sciences at Northern Illinois University, and Fulbright Senior Lecturer/Research Award in Mexico. He has been funded by the Ford Foundation, U.S. Small Business Administration, and other agencies, and serves on five journal editorial boards.

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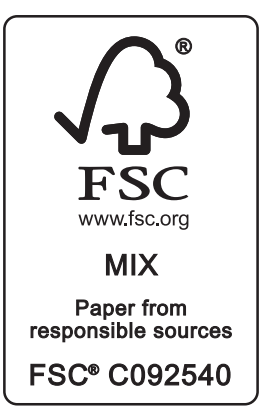

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CHAPTER

1 The Spatial Display of Urban Environments

Urban geography is the study of urban areas and cities based on geographical principles. It includes multiple dimensions of their spatial distributions, activities, and functioning. The study of urban geography is important because 50 percent of the world's population lived in urban areas in 2008 (see Figure 1.1) and the world's urban population is expected to double by 2050, with most of that growth coming in the cities of the developing world (United Nations, 2008). Urban areas are the centers of government, economic activity, and business decision making, as well as the primary markets of culture and intellectual accomplishment. Urban geography is aligned with sociology, economics, and urban planning, from which it draws and gives back ideas and knowledge. A geographic information system (GIS) is a modern tool that helps in understanding and analyzing urban spatial distributions and their change over time.

This chapter sets the stage for the book by defining and justifying the importance of urban geography and pointing out why applying spatial analysis to the study of urban geography is a useful approach. It discusses several other geographical approaches that inform the study of the city, including physical, cultural, political, and economic geography. It examines the international view of urban geography, the reasons cities have become more international, and the growth of megacities. An example of an urban issue—the pattern of urban growth and change—is presented for the Sunbelt in the United States. The principles and contributions of the Chicago, Los Angeles, and New York City schools of thought are explained. Quantitative techniques, spatial analysis, and the computer, which have supported more systematic and data-based study of cities and urban areas, have all influenced urban geography. Besides the spatial view, other views of urban geography—political, behavioral, urban economic, and urban historical—are introduced. The chapter turns to explaining how Google Earth is used throughout the book to help in the study of urban geography. Both Google Earth and ArcGIS exercises reinforce chapter principles in urban geography. The approach of the textbook is explained by a summary of its content, its chapter organization, and the role of the Google Earth and ArcGIS practice exercises.

1.1 THE STUDY OF URBAN GEOGRAPHY

Urban areas represent and support most of human activity. They are not only the main focus of civilizations, but also dynamic and vibrant forms of community. In their long history, they have been the primary locus for development of social movements, intellectual ferment and discoveries, and the rise and fall of nations and civilizations. For instance, Roman civilization is tied to Rome; jazz to New Orleans, Chicago, and New York; and the Midwest to Chicago, Milwaukee, and Detroit.

Cities exist to form places for economic, social, and political interchange, control, and innovations. Over time, these reasons have changed because of alterations in underlying societal processes that include demographic, economic, political, cultural, and technological changes. For some larger cities, global exchange has been a key factor in their rationale and functioning. The processes that produce and continue to change urban agglomerations are covered in Chapter 4. An example is the influence of the industrial age in the 19th century on cities. Cities grew and changed as manufacturing zones developed, new forms of transportation such as railroads were introduced, new places were established for industrial workers to live, and manufacturing cities became interconnected because of economic dependencies.

The study of urban areas and cities is essential. Fortunately, much is known about their social, economic, historical, and geographical evolution. Through this knowledge, real-world practitioners can perform their jobs better. Urban geography can help city planners to understand city sectors

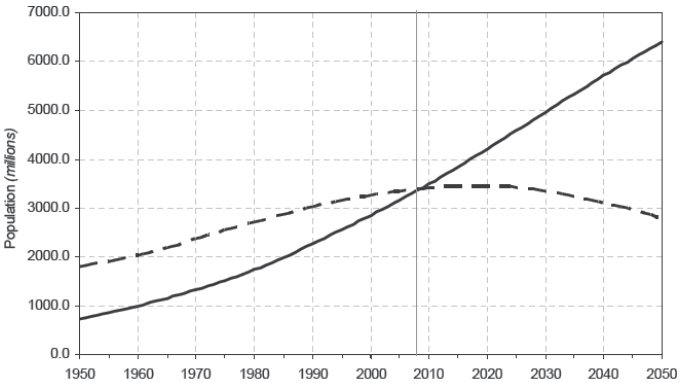


FIGURE 1.1 Urban and rural populations of the world: 1950–2050. *Source:* United Nations. (2008). *World Urbanization Prospects: The 2007 Revision*. New York: Author.

and neighborhood change patterns, politicians to learn about neighborhood attributes and the attitudes of their residents, and public health officials to unravel the spatial patterns of human contacts and the spread of disease.

Urban geography depends on the arrangement of phenomena in space. Space is important in the city because it determines the relationships of people, transport, neighborhoods, industry, communications, and environment. How do apartment rentals change from the city center in the westward gradient? How do two neighborhoods change in their attributes and interrelationship with each other over time? How is urban ethnic diversity changing throughout the city? How long does it take citizens in different areas to reach the nearest hospital? How do the city's residents relax and engage in leisure activities? (See Post Alley near Pike Place Market in Seattle in Figure 1.2.) These and other crucial questions can be answered through geographical analysis. The concepts of space have changed as the cities' underlying processes have altered. For instance, as more automobiles were introduced in the 20th century, American cities spread out over the possible car-commuting range, a tendency that later led to their sprawl over large spaces.

Within geography, urban geography is linked to *cultural and human geography* because cities have cultural, societal, and human aspects; *physical geography* because they have terrain, rivers, lakes, and floodplains; *economic geography* because economic activities are constantly occurring; and *environmental geography* because there is a complex urban environment.

Unlike many subdisciplines of geography, urban geography is relatively new and was not actually offered as a specialization in universities prior to World War II. This is not to say that some courses were not offered or that geographers were not looking at cities—in fact, they were, but not with as large a knowledge framework as today.

> By the Second World War, . . . the situation had been reached where a rapid growth of urban geography was inevitable. Preliminary foundations had been laid and many of the basic ideas had been propounded, although in isolation. In many ways the recent expansion in urban geography had been mainly concerned with exploitation of ideas already in existence in the 1930s. (Carter, 1972, p. 5)

Geographers Mayer and Kohn recognized this evolving synergy for urban geography and compiled what can be considered the first American textbook in urban geography (Mayer & Kohn, 1959). Their collection of readings focused on urban functions, forms, distributions, and growth, the primary urban topics geographers had examined up to that time.

Even at the time that Mayer and Kohn had edited their collection of readings, two contrasting approaches in urban geography were becoming well defined. These were the *urban systems approach* and the *internal structure of cities approach*. The urban systems topics ranged from central place theory, formulated first by Christaller in the 1930s, to the study of cities as nodes, with an emphasis on modeling the interaction among the nodes. Textbooks eventually appeared that broke up the two approaches into major sections. Two books devoting substantial coverage to the urban systems approach were *City and Region* by Dickinson (1964) and *Geographic Perspectives on Urban Systems* by Berry and Horton (1970). A key principle of the urban systems approach is that there are underlying economic, social, and political processes that account for spatial variation in phenomena throughout the urban system. These processes and their interaction with urban systems are of major concern to the urban systems approach, as are central place theory and others discussed in Chapter 4. Coverage is also given to this approach in Chapter 6, particularly in the section on migration. The section of this chapter titled "Analyzing an Urban Issue: Sunbelt Growth" and the coverage in Chapter 4 on central place theory are examples of the urban systems approach.

FIGURE 1.2 Post Alley near Pike Place Market in Seattle.

FIGURE 1.3 A city market in Mexico City.

The internal structure of cities approach examines the same economic, social, and political processes, but focuses on how the spatial outcomes play out in the city and urban area. A 1982 urban geography textbook bearing the same name, *Internal Structure of the City*, was a volume of readings edited by Bourne that articulated the approach with examples from 64 authors. Bourne introduced three terms to describe the focus of the internal structure approach: urban form, urban interaction, and urban spatial structure. *Urban form* is the spatial pattern of features in a city—for instance, a working-class Latino neighborhood and an upper-income White neighborhood. *Urban interaction* refers to the linkages and flows that integrate the various features of the city. For example, interaction could be represented by the contrasting routes the two types of households take to work. In the Latino case, women-the overwhelming majority of domestic workers—would move daily into the upper-middle-income neighborhood; in the White case, many workers would commute to a nearby office park or to the city's main downtown area. Flows of buyers and sellers interact daily in outdoor markets in Mexico City (see Figure 1.3). *Urban spatial structure*, according to Bourne, is the highest level of analysis, as it represents the organizational linkages that connect urban interaction and urban form into a cohesive system. In the neighborhood example with its associated workers commuting to their jobs, variation in wage rates among local employment centers might be taken into account to explain the different patterns of movements and how they are tied to the occupational skill levels of the neighborhoods themselves.

The internal structure of cities approach occupies much of this book. We consider important social and cultural processes that impact the city and its institutions; how people behave, cooperate, and clash; and how government institutions grow, change, and affect the city's urban form. The patterns and processes of the natural environment are considered in terms of urban form and urban interaction because terrain influences city form and contaminants influence its quality of life. However, not all groups in the city are affected by pollution to the same degree. The field known as *environmental justice* seeks to understand these inequities. It requires an understanding of urban spatial structure. Transportation facilitates urban interaction through the movement of people, goods, and services, both within and between cities, and is often used as an example throughout the book.

Urban geography is closely aligned with some other academic disciplines, including urban sociology, environmental economics, political science, urban and regional planning, and demography. None of these urban disciplines has the last word on urban processes, but often content is shared or overlapping. Urban sociology focuses particularly on the sociological forces and processes in cities, addressing topics such as cities' social structure, social stratification, power structures, family units, crime, and disorganization. Environmental economics includes analyses of the economic costs, benefits, and trade-offs of pollution. Political science includes urban politics, political geography, and political change, and urban and regional planning is concerned with the theory and practice of planning city development. In this book, we refer to some concepts and ideas from these and other disciplines.

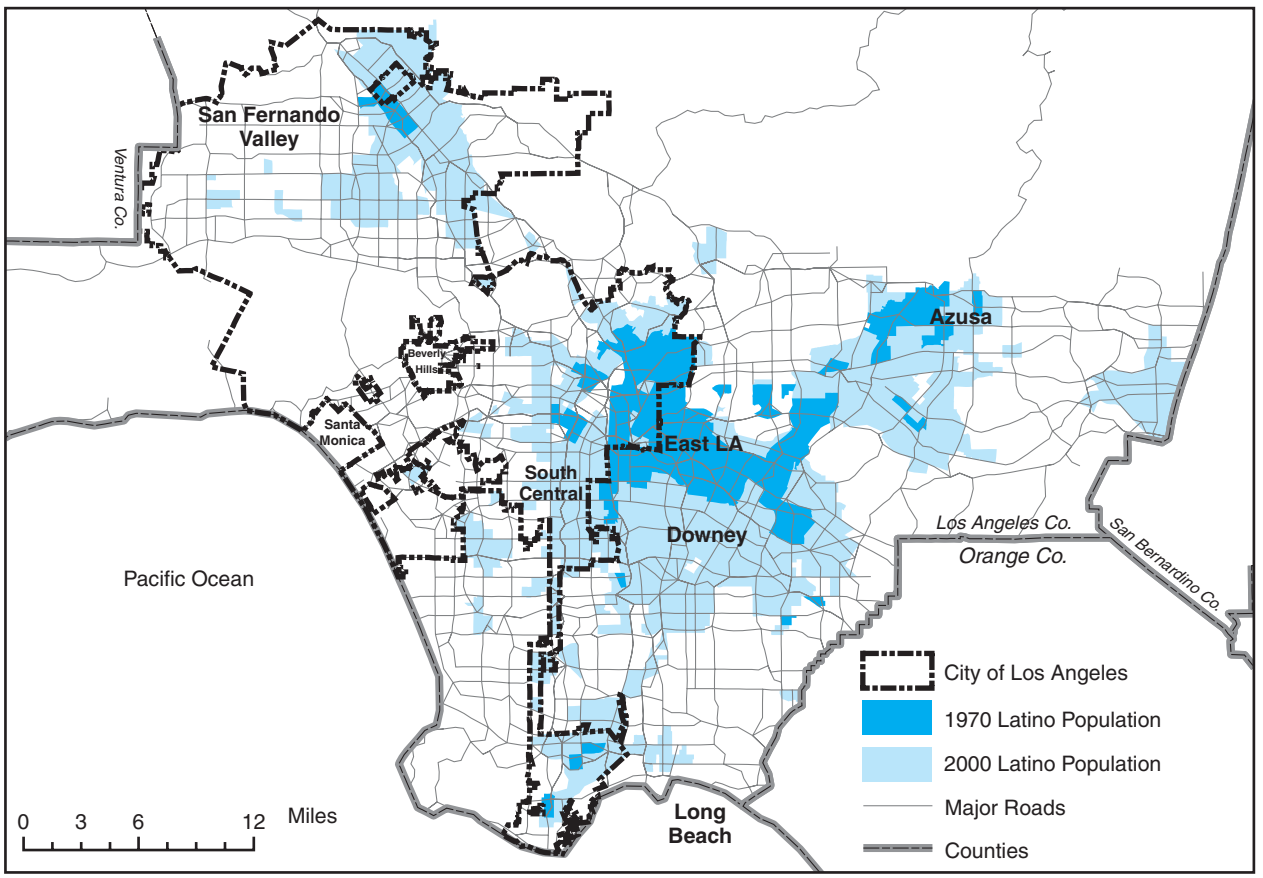


FIGURE 1.4 Areas in Los Angeles County with a Latino population of at least 50 percent, 1970 and 2000. *Source:* U.S. Census, 2000.

1.2 URBAN GEOGRAPHY AS A DISCIPLINE: ITS IMPORTANCE

For a preliminary glimpse at urban geography, consider a map (see Figure 1.4) showing areas in Los Angeles where the Latino population was 50 percent or greater in 1970 and 2000. It is clear that the Latino population spread vastly. In 1970, the Latino population was concentrated in the East Los Angeles area, with some small concentrations in the San Fernando Valley, well to the northwest of East Los Angeles; Azusa to the east; and Downey to the south. By 2000, it had become widely spread out in a much larger area, occupying a large part of the central-western section of Los Angeles, a large section of the northern San Fernando Valley, and some areas in the South Bay area northwest of Long Beach. During the same time span, the area of Black population concentrated in south-central Los Angeles was reduced in size, while the entire Los Angeles metropolitan area expanded over the three decades. Another feature discussed more in Chapter 2 is that the unusual shape of the Los Angeles city boundaries leaves pockets within it for other cities, such as Beverly Hills and Santa Monica (see Figure 1.4). This stems from the city's rapid growth, as formerly outlying cities were enveloped by it.

Figure 1.5 shows the ethnic components of Los Angeles County from 1940 to 2000. In 1940, the county was 93 percent non-Hispanic White and only 2.2 percent Latino. The Latino population grew steadily over 60 years, and by 2000, it comprised 45 percent of Los Angeles County. From 1970 to 2000, the Latino segment of the county increased by 17 percentage points, or 2,953,597 more Latino persons. By contrast,

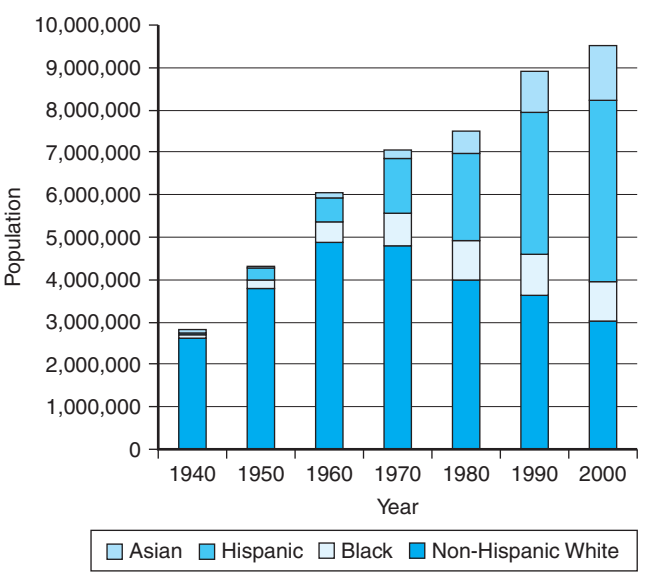


FIGURE 1.5 Ethnic components of the population of Los Angeles County. *Source:* U.S. Census, 1940 to 2000.

the proportion of non-Hispanic Whites was reduced to less than half, and the share of the Black population remained steady at 10 percent. Not only are nearly half of Los Angeles County's residents Latino, but also they are now widely distributed, so that few parts of Los Angeles did not have a Latino population in 2000.

The ramifications of this urban change are large. What has happened to the buying habits of consumers? What are the changes to the perceived importance of Latin American and Mexican cultures? Given that the average Latino household tends to be larger than the average non-Latino White household, how is housing affected? Where are the new migrants to Los Angeles coming from? What are the educational profiles of new migrants coming to these Latino areas from Mexico and other countries? This small example shows the important contributions stemming from urban geography, illuminating the effects of major urban change on how people live and work and on how they interact with each other.

Geographical analysis can also be *comparative*. This means comparing several cities, comparing a city to its surrounding region or hinterland, or comparing different parts of a single city. If we look at the downtown and transportation matrix of Los Angeles compared to those of St. Louis, we observe very different patterns (see Figure 1.6). St. Louis contains a long-established central downtown, which is located at the central hub of the city's transportation network. By contrast, the main downtown of Los Angeles has many rivals, and none of them dominates as the transportation hub. This example shows that the comparative approach can yield insights beyond what is available in just one city or the other.

1.3 AN INTERNATIONAL VIEW OF URBAN GEOGRAPHY

Another dimension of this book is to provide an international perspective. This is accomplished by including international urban examples and information. Foreign cities are important to examine in an urban geography text. The world is shrinking because of continual advances in transport and communications, growing trade, and language diffusion (especially English). For instance, the fastest travel time for passengers to go from Chicago to New York was 8 hours in 1900. Today, it is 2 hours. English is widely dispersed around the world, and its use encourages communications. Presently, 5.5 percent of the world's population have English as their primary speaking language, second only to Chinese at 20.4 percent (Lewis, 2009). Moreover, 8.5 percent of the world's population speak English when their second language is also counted (Lewis, 2009).

Most of the world's population growth in the 21st century will occur in the developing world, and that will be predominantly in cities. The world's count of megacities (those urban agglomerations with 10 million or more persons) has grown from 2 in 1950 (New York and Tokyo) to 19 in 2007 (see Table 1.1). Of the 19 cities, 15 are in developing nations, and only 4 are in the more developed nations. The seven largest megacities in 2007 were Tokyo, New York, Mexico City, Mumbai (Bombay), São Paulo, Delhi, and Shanghai. Five of these are in the developing world. In this chapter section and its tables, Tokyo refers to the Tokyo greater metropolitan area, which consists of Tokyo and Yokohama. The United Nations predicts that the ranking will change by 2025, with 8 of the 10 largest megacities found in the less developed countries (Table 1.2 on page 7). In 2025, Tokyo will still be the largest megacity, at 36.4 million inhabitants, followed by Mumbai, India, at 26.4 million, and Delhi, India, at 22.5 million. Continuing an expansion of more than a century, the greater Tokyo urban area grew moderately, by about 1.4 million, in the 1990s (United Nations, 2003). The United Nations refers to this urban agglomeration as Tokyo, although it is sometimes called Tokyo–Yokohama. A comparison of the top megacities in 1975 and those projected in 2025 shows an increase of 24, with 8 to be added after 2007.

If the current trends evident on this time line persist, the developed-world cities that were among the world's largest cities in 1975 will have been somewhat superseded in 2025 by numerous megacities located in the developing world—especially Asia, Africa, and South America—and at more southerly latitudes. The implication for the study of urban geography is that its models and methods will need to adapt to include these new giant cities in less developed regions. It points to the importance of understanding the cultural and economic development aspects of these megacities.

As one instance of an attribute that differs internationally, consider poverty as measured by the percentage of low- or no-income inhabitants in greater Mexico City in 2000

TABLE 1.1 The World's Megacities (Population of 10 Million or more), 2007

Rank	Urban Agglomeration	Population (Millions)
1	Tokyo, Japan	35.7
2	New York–Newark, USA	19.0
3	Ciudad de México (Mexico City), Mexico	19.0
4	Mumbai (Bombay), India	19.0
5	São Paulo, Brazil	18.8
6	Delhi, India	15.9
7	Shanghai, China	15.0
8	Kolkata (Calcutta), India	14.8
9	Dhaka, Bangladesh	13.5
10	Buenos Aires, Argentina	12.8
11	Los Angeles–Long Beach–Santa Ana, USA	12.5
12	Karachi, Pakistan	12.1
13	Al-Qahirah (Cairo), Egypt	11.9
14	Rio de Janeiro, Brazil	11.7
15	Osaka–Kobe, Japan	11.3
16	Beijing, China	11.1
17	Manila, Philippines	11.1
18	Moskva (Moscow), Russian Federation	10.5
19	Istanbul, Turkey	10.1

Source: United Nations. (2009). *World Urbanization Prospects: The 2007 Revision*. New York: Author.

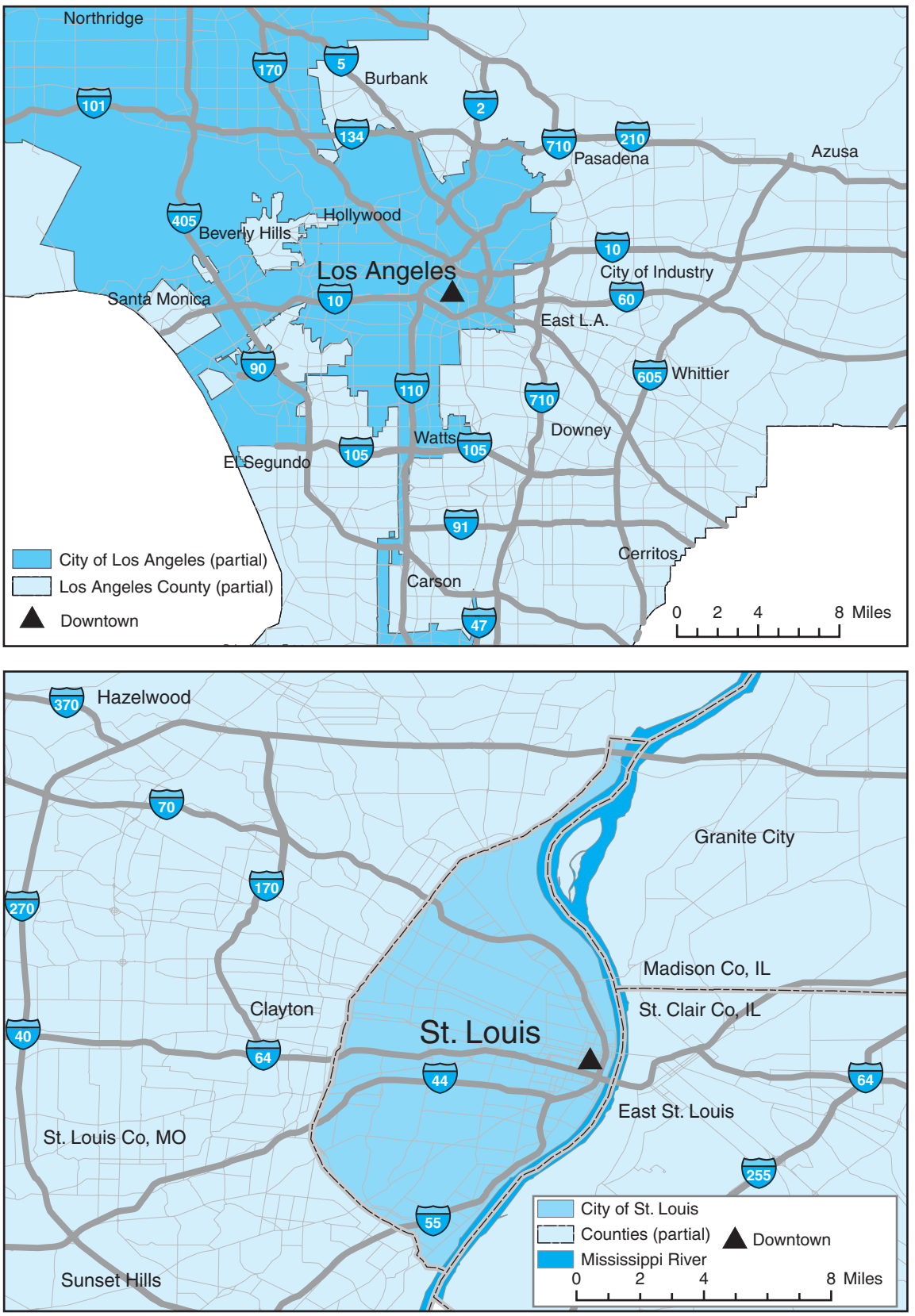


FIGURE 1.6 City center comparisons for Los Angeles and St. Louis.

TABLE 1.2 The World's Megacities, 1975 and 2025

1975			2025		
Rank	**Urban Agglomeration**	**Population (Millions)**	**Rank**	**Urban Agglomeration**	**Population (Millions)**
1	Tokyo, Japan	26.6	1	Tokyo, Japan	36.4
2	New York–Newark, USA	15.9	2	Mumbai (Bombay), India	26.4
3	Ciudad de México (Mexico City), Mexico	10.7	3	Delhi, India	22.5
			4	Dhaka, Bangladesh	22.0
			5	São Paulo, Brazil	21.4
			6	Ciudad de México (Mexico City), Mexico	21.0
			7	New York–Newark, USA	20.6
			8	Kolkata (Calcutta), India	20.6
			9	Shanghai, China	19.4
			10	Karachi, Pakistan	19.1
			11	Kinshasa, Democratic Republic of the Congo	16.8
			12	Lagos, Nigeria	15.8
			13	Al-Qahirah (Cairo), Egypt	15.6
			14	Manila, Philippines	14.8
			15	Beijing, China	14.5
			16	Buenos Aires, Argentina	13.8
			17	Los Angeles–Long Beach–Santa Ana, USA	13.7
			18	Rio de Janeiro, Brazil	13.4
			19	Jakarta, Indonesia	12.4
			20	Istanbul, Turkey	12.1
			21	Guangzhou, Guangdong, China	11.8
			22	Osaka–Kobe, Japan	11.4
			23	Moskva (Moscow), Russian Federation	10.5
			24	Lahore, Pakistan	10.5
			25	Shenzhen, China	10.2
			26	Chennai (Madras), India	10.1
			27	Paris, France	10.0

Source: United Nations. (2009). *World Urbanization Prospects: The 2007 Revision.* New York: Author.

(see Figure 1.7 on page 8). *Low income* is defined as income less than the minimum wage. The map shows the two parts of Mexico City, the central part located in the acorn-shaped Federal District and the more outlying part in the State of Mexico, which surrounds the Federal District. The base maps for the Mexico City metropolis are discussed further in Chapter 3. It can be seen that the percentage of the workforce with no or low income is moderate to low in the downtown city center and wealthier residential areas to the west. The downtown is located in the upper middle of the Federal District. Poverty is very high in areas way out at the urban fringe to the northeast and southeast, which might stem from their being more rural. Also, in Latin American cities, the poor arriving migrants tend to flow to available "squatter" land on the periphery (Elbow & Pulsipher, 2003; Wigle, 2010). This differs from U.S. cities, in which the poor tend to be located in the inner part of the city near the downtown, whereas the suburbs and fringe areas have fewer pockets of poverty.

Although having prosperous business and commerce, Mexico City's downtown city center also has a population of poor street vendors and other informal labor forces, some of whom reside in the city center. As in many large Latin American cities, smaller pockets of very poor population are interspersed within mostly wealthy zones, a pattern that has ramifications for working patterns and government planning. For instance, poor inhabitants on the periphery cannot afford automotive transport to commute to jobs in or adjoining the city center, which underscores the need for a cheap and massive public transport system. An area of poverty near the Mexico City periphery is seen in Figure 1.8. On another note, urban planning in Mexico City, as in most U.S. cities, is based less on a zoned approach and is more political and unregulated in nature. Poor squatters are able to arrive and claim land without violating zoning laws and usually will not be evicted. Their settlement is influenced by local social relations and property customs and practices (Wigle, 2010).

Thus, studying developing-world cities teaches us that there is not one way for urban processes to occur, but alternative ways culturally and societally. We return later in the book to the question of international differences among cities.

In summary, urban geography examines development, growth, and processes in cities and urban areas in a geographical context. It reflects the many dimensions of the city, including economic, social, human, political, environmental, and physical. Urban geography interacts with many neighboring

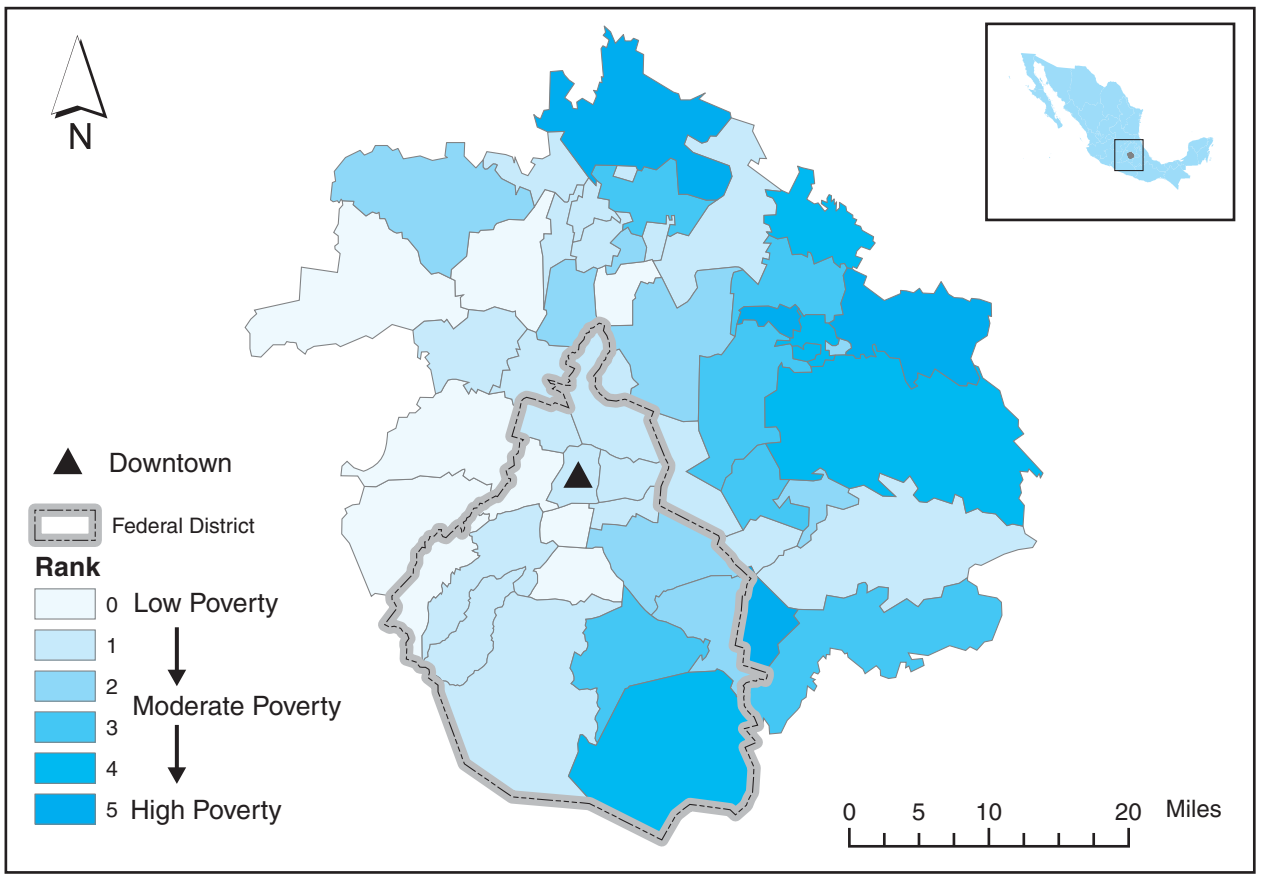


FIGURE 1.7 Low- or no-income ranks within Mexico City metropolitan regions (2000 metropolitan definition).

FIGURE 1.8 Poverty on Mexico City's periphery.

disciplines, so it is not surprising that a variety of perspectives have emerged within the field itself.

To demonstrate the urban geography approach, the next section examines an urban issue—the growth of Sunbelt cities—from a geographical perspective. The expansion of Sunbelt cities serves as the book's first in-depth example of change in cities and some of the processes underlying this change, especially migration flows. It is an influential issue that has involved the work and lifestyle of millions of Americans over several decades. This urban issue is later pursued in the chapter's Google Earth and ArcGIS laboratory exercises.

1.4 ANALYZING AN URBAN ISSUE: SUNBELT GROWTH

Conventionally, U.S. Sunbelt cities, as shown in Figure 1.9, have been defined as those fast-growing cities that are located below the 37th parallel (Bernard & Rice, 1983). This definition reflects the southward and westward movement of people from the cities of the Northeast and the Midwest to the many cities of the South and West. The skyline of the Sunbelt city of Houston, Texas, is shown in Figure 1.10. Mention of the Sunbelt often conjures up an image of destination cities with amenity-rich coastal settings and abundant job generation. However, drawing the line in the sand to demarcate the Sunbelt is difficult. In fact, there might not be a distinct line demarcating the Sunbelt, based on the characteristics most associated with it. If Sunbelt cities are defined solely in terms of population growth and the southern location criterion is ignored, then the Sunbelt might include not only the fast-growing cities of the South and West, but also some cities along the entire Pacific Northwest coast and in the Mountain West.

How might an urban geographer explain this trend? One historical reason cited for the growth of Sunbelt cities was defense and other federal spending that was biased toward southern and western cities (Tabb & Sawers, 1984). Oil and gas exploration and development in Texas, Oklahoma, and Louisiana in the 1970s and early 1980s helped spur growth in those regions of the Sunbelt. A boom in high-technology industries and growing affluence, as well as an expanded service and information economy, have also added to Sunbelt city growth. Another factor is the introduction of moderate-priced air conditioning after World War II. This added to the attractiveness of seasonally hot and sometimes humid locations in the South and West. Although the more general of these trends have been seen across the United States as a whole, it has been well documented that the availability of relatively more jobs and higher competitive wages has been a strong attraction for the South and West (Greenwood & Hunt, 1989; Piet, 1998). This trend shifted in the Great Recession of 2007–2009, so that some places in the Sunbelt such as Austin, Texas, continued to attract migrants, while others hard-hit by housing problems such as Los Angeles no longer attracted them (Wial & Friedhoff, 2010).

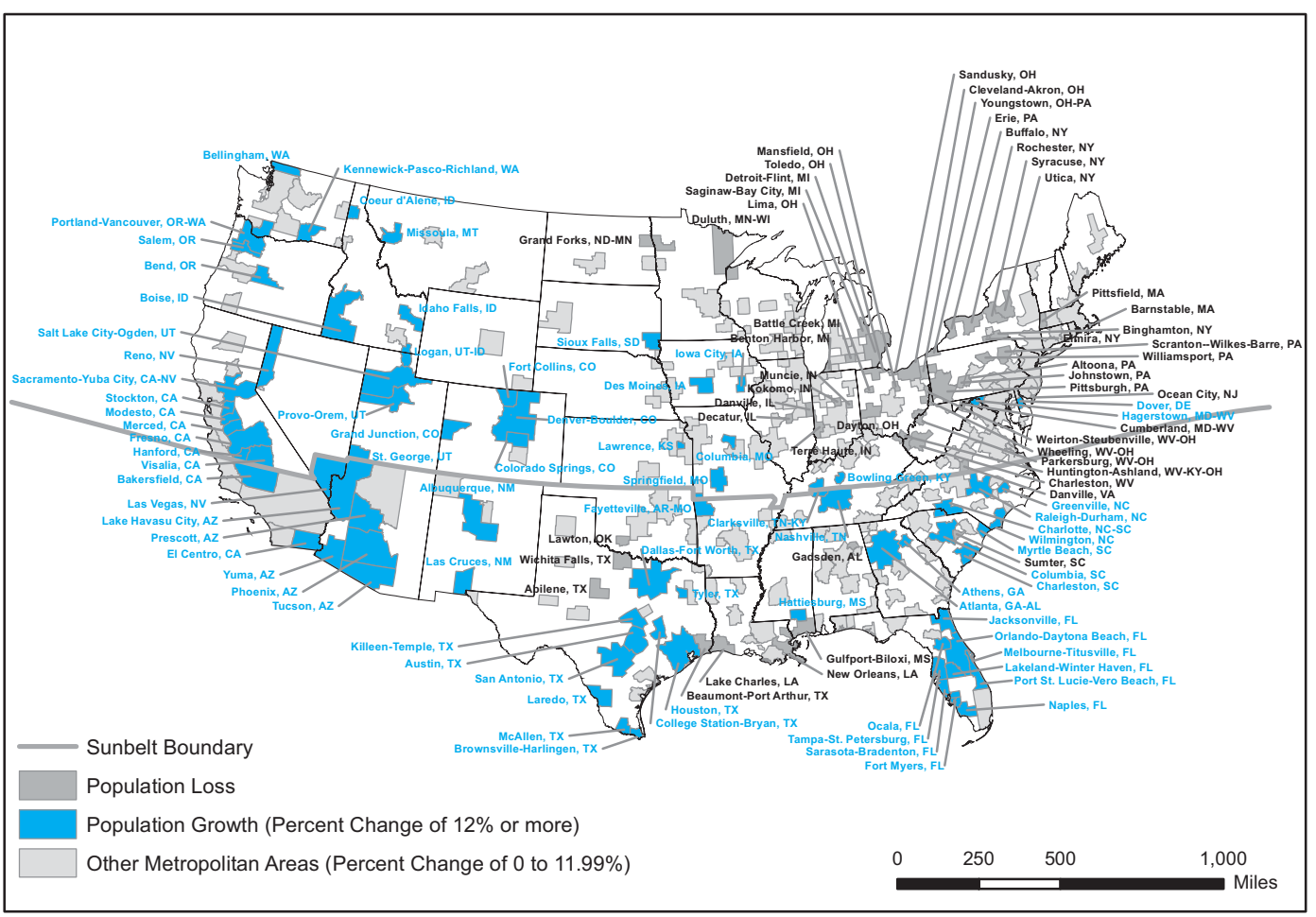


FIGURE 1.9 Metropolitan growth in the 48 conterminous United States: 2000–2008.

FIGURE 1.10 Houston skyline.

Florida and Arizona can attribute much of their early and continued expansion to the growth of retirement communities. It will likely be augmented by the retirement of those in the baby boomer generation, which began around 2005. On the other hand, these regions could lose some population as retirees reach their eighties and nineties and some of them return from Sunbelt retirement areas to their places of previous residence in the North. In support of this, Manson and Groop (1996) observed an actual decline in interstate movers to the South and West during the early 1990s, whereas interior areas outside of the South and West showed increases. Their study also noted that the impressive overall migration to California in the 1980s turned around to substantial migration losses between 1990 and 1993. Nevertheless, in spite of the Great Recession, the heavy concentration of recreation and the tourism industry in Florida, southern California, and Las Vegas is a resilient magnet for longer-term sustained growth in those regions.

In the 1990s, city growth followed the same basic patterns found in the earlier Sunbelt literature. In particular, the half-century-long trend of people moving to places with good weather, low population density, and skilled inhabitants continued (Glaeser & Shapiro, 2001). The presence of skilled inhabitants implies that there are also jobs for migrants. However, there was no general rebirth of high-density cities typical of the Northeast and Midwest in the Sunbelt. Glaeser and Shapiro (2001) also pointed out that some cities experiencing rapid growth outside of the defined Sunbelt were unusually well endowed with college graduates, reflecting the attraction of universities. For instance, the university cities of Lawrence, Kansas, and Charlottesville, Virginia, are both outside of the Sunbelt, but are identified in the GIS database of the lab exercise as rapidly growing. Another factor continuing to attract migrants to the Sunbelt is the convenience and comfort associated with air conditioning.

Prior to the 1970s, the largest metropolitan areas grew at a faster pace than did the United States as a whole, but this trend was reversed in the 1970s, when population densities declined across the entire urban hierarchy and internal migration flowed from the Northeast and Midwest to the South and West (Greenwood, 1988; McHugh, 1988; Plane, 1992). Technological changes allowed the full diffusion of urban amenities to all parts of the country and increased the importance of environmental, lifestyle, and location amenities in the residential decision-making process (Frey, 1993). People moving to less dense places often cite quality-of-life reasons for their decisions (Fuguitt & Brown, 1990).

Others have pointed to the importance of the age of migrants as a factor in Sunbelt flows. They argue, for instance, that the largest numbers of baby boomers were born in the Northeast

and Midwest, the dominant urban employment locations of their parents' generation. This very large cohort of young persons born from 1946 to 1964 entered the age bracket of maximum personal mobility in the 1970s (Borchert, 1983). However, the economic downturn in much of the Northeast and Midwest in the 1970s meant that these areas could not absorb this large cohort of new workers into their labor force. Consequently, net migration accelerated from the Northeast and Midwest to urban destinations in the South and West (Plane, 1992).

Immigration is another factor cited for Sunbelt growth. International immigration flows to key urban areas of the United States have become quite large, often overshadowing earlier internal migration patterns (Champion, 1994; Frey, 1994; Walker, Ellis, & Barff, 1992). As seen in Chapter 7, from the Civil War to World War I, most immigrants came from Europe. For instance, at the turn of the last century 80 to 90 percent of the immigrants were European. As a result, East Coast port cities such as Boston, New York, and Philadelphia were the principal recipients of these immigrants. Waves of immigrants continued to arrive, replacing those who had moved on to the cities of the Midwest and elsewhere.

The Immigration and Nationality Act Amendments of 1965 altered the limits on the number of immigrants legally allowed from each country, which resulted in much higher levels of the "new immigrants," a phrase used to designate immigrants from Latin America and Asia (see Chapter 7). By the 1980s and 1990s, 80 percent of the immigrants were from these regions. The shift in point of origin for most immigrants has been reflected in changes in the main immigration ports of entry. Borchert (1983) observed that the 1970s foreign-born stream settled largely in southern and southwestern metropolitan areas that had reached populations comparable to those of the 19th-century ports of entry for the manufacturing belt. The manufacturing belt refers to manufacturing concentrated in the industrial states stretching across the Northeast and Mid-Atlantic into the Midwest. All this has fueled metropolitan growth rates in the South and West, as many immigrants typically settle, at least initially, near their points of entry (Carlson, 1994; Champion, 1992, 1994; Frey, 1993, 1995). McHugh (1989) noted that the heavy influx of immigrants in the 1980s allowed metropolitan areas in the South and West to continue to grow rapidly despite a decline in internal migration. The influx into the United States of Mexican immigrants continued in the 1990s, but slowed in the 2005–2009 period due to the recession (Passel & Cohn, 2009).

In summary, there are many factors offered to explain the spatial patterns in the growth of cities in the South and West. Many of the explanations proposed are from urban geographers or persons from related disciplines employing the spatial perspective. In this chapter's Google Earth and GIS lab exercises, you will be able to analyze Sunbelt growth trends for U.S. metropolitan areas during the 2000–2008 growth period to build on these many observations.

The next section illustrates the importance of the study of urban geography and of GIS with the example of Hurricane Katrina, which ravaged the city of New Orleans and other surrounding Sunbelt areas. This is followed by two sections which introduce two schools of thought that have been influential in urban geography over the past 80 years. The Chicago School established a foundation for understanding the spatial arrangement and ecological functioning of cities. Its concepts were based on American cities, especially Chicago in the 1920s, but they have been influential in shaping thought on subsequent models of space. The more recently formed Los Angeles (L.A.) School has adopted postmodernist thought and built a theory that includes the impact of urban sprawl, urban design, culture, and globalization. That school based some of its thinking on Los Angeles as a prototype, but its thought extends to a range of contemporary cities.

1.5 HURRICANE KATRINA AND THE STUDY OF URBAN GEOGRAPHY

Hurricane Katrina was one of the greatest hurricanes to impact a large urban area. It struck New Orleans on August 29, 2005, causing great loss of life and damage to property. Estimates are that 1,300 people were killed, 100,000 city residents had to be relocated, and property losses were $125 billion dollars (Baade, Baumann, & Matheson, 2007; Cutter et al., 2006). Since then, the city has struggled with obtaining funding, rebuilding the infrastructure and economy, repopulating the city, and regaining the city's spirit and cultural legacy.

New Orleans was founded in 1718 by the French. It served as an economic center of trade and commerce stemming from its location near the mouth of the Mississippi. By 1840, New Orleans ranked third in population in the United States (Lewis, 2003). It was a center of the slave trade up to the Civil War, the birthplace of jazz, and increasingly in the 20th century a tourism city. New Orleans before the disaster had large poverty areas and socioeconomic divisions, with a substantial Black population located mostly in vulnerable and low-lying areas, including its impoverished Ninth Ward. Its population in 2000 was 484,675, but in 2006, after Katrina, it had fallen to 210,768. The city's resiliency was evident in its growth by 2008 to 311,853 (U.S. Census Bureau, 2009).

Like many cities, New Orleans has vulnerability to natural disasters—in its case, due to the combination of low ground; reduction of protective swamps, marshes, and lowlands; and flood pumping facilities that were becoming outdated. City planners and environmental officials were aware of the threat of flooding, but considered it a low and remote risk.

When Hurricane Katrina suddenly struck, most residents fled the city, many not to return. The severe flooding in low-lying zones, seen in Figure 1.11, caused enormous damage to and loss of buildings and possessions, as well as loss of life. Seventy percent of the city's residences were seriously damaged (Colten, Kates, & Laska, 2008). In the immediate crisis, city services were largely halted, and the state and federal responses were slow.

As the emergency phase ended after about six weeks, a long and difficult recovery phase began. The problems confronting the city have included stimulating jobs; rebuilding moderate- and low-priced housing; restoring networks of hospitals, public housing, and public services; reconstructing storm levees; and bringing back the hospitality sector and tourists (Colten et al., 2008; Nossiter, 2007). Some poverty areas that were destroyed are not likely to be fully rebuilt. Although New Orleans can regain economic strength and population over time, some of its culture will be lost, leaving it without the people who will never return

FIGURE 1.11 Hurricane Katrina.

(Baade et al., 2007; Li, Airriess, Chen, Leong, & Keith, 2010). Neighborhoods, such as one consisting of Blacks and Vietnamese Americans (Li et al., 2010), have had particular evacuation routes, destinations, and rationales on whether to stay away or return. There are also psychological and behavioral impacts on people who experienced Katrina that might take a generation or more to be resolved. Nevertheless, in the outfall of the disaster, the city has shown community resilience (Colten et al., 2008) and has produced long-term plans and made much progress toward recovery (Barnett & Beckman, 2006). For instance, by 2008 the hospitality and tourism economy was largely restored, 30 percent of residences in the city were issued building permits, and levees were largely rebuilt stronger than before (Colten et al., 2008). This disaster represented such a collapse of the urban society of New Orleans that it even challenged how scholars think about the concepts of urban and city (Steinberg & Shields, 2008).

This example of a natural disaster points to aspects of the urban community that will be addressed throughout this book, such as migration in Chapter 6, race and ethnicity in Chapter 7, the environment in Chapter 10, and urban planning in Chapter 11. Katrina and its aftermath were largely defined by place, proximities, and distances, so GIS was a key tool utilized by the hurricane emergency teams and by those involved in the planning and implementation of long-term recovery.

1.6 THE CHICAGO SCHOOL AND ITS LINK TO URBAN GEOGRAPHY

A neighboring discipline to urban geography is urban sociology, particularly the urban sociology that developed in Chicago in the early 1900s, which had a significant effect on the spatial perspective of urban geography. This was due in large part to Robert Park (1864–1944) and Ernest Burgess (1886–1966), sociologists at the University of Chicago who guided generations of sociology students doing research on the city of Chicago, many of them on spatial topics. The theories of Park and his associates became known as the human ecology approach to the study of urban development, which was put forth in Park's classic 1925 essay, "The City: Suggestions for the Investigation of Human Behavior in the Urban Environment" (Chapter 1 in Park, Burgess, & McKenzie, 1925). Park's paper had a profound impact on the development of both sociology and geography in the United States. Many of the students of the city and urban conditions in the early 20th century were at the University of Chicago, which had been established in 1892. In addition, Chicago at the turn of the century was one of the fastest-growing major cities in the world, due in large part to immigration. The Chicago School, as sociologists Park, Burgess, and McKenzie became known, wanted to learn how immigrants were assimilated

into the city; Chicago became a laboratory for this endeavor. As a result, many leading urban concepts were originated through the study of Chicago, and other American cities were less fully investigated. A genealogy of North American urban literature today would reveal that much of it has roots going back to Chicago.

Park believed that the community operated on two levels. The first was the *biotic level,* which was based on competition and division of labor, concepts that were derived from Darwin's principle of divergence and "tree of life." The second was the *cultural level,* with a focus on communication and consensus on the moral order. Park argued that the proper focus for human ecology was the biotic level, whereas analysis of the cultural level was considered a problem for social psychology. Thus, the human ecology approach was to view the human community as a dynamic adaptive system; competition served as the primary organizing agent. Under the pressure of competition, each individual and group was seen as carving out in the city both residential and functional niches in which they could best serve and prosper. The eventual effect of competition was to segregate people and their businesses into relatively homogeneous residential and functional subareas within the community.

Park, Burgess, and McKenzie published Park's original essay along with others in a book entitled *The City* (Park et al., 1925). Burgess wrote the book's second essay and developed the diagram, now classic, that illustrates the concentric zone model of urban development. In this model, the inner ring or zone consisted of the central business district (CBD). It was encircled by successive zones of transition, working-class housing, middle-income housing, and commuters. The concept was both spatial and temporal. As time passed, the zonal structure continued, but the entire system expanded; that is, the zones expanded outward, consuming additional territory. Burgess contended that the system changed because of the processes of neighborhood change expressed in Park's first essay in the book. The topic of zonal patterns of urban development is reviewed in greater detail at the beginning of Chapter 3 along with other subsequent theories of urban spatial structure.

The third essay, by McKenzie, also had a strong spatial component, as demonstrated by the following excerpt:

> [S]ociety is made up of individuals spatially separated, territorially distributed, and capable of independent locomotion. These spatial relationships of human beings are continuously in process of change as new factors enter to disturb the competitive relations or to facilitate mobility. (Park et al., 1925, p. 64)

Park, Burgess, and McKenzie's use of social Darwinism to explain the dynamics of city growth caused many scholars of the city to oppose the Chicago School's ideas. Nevertheless, their literature provided much of the foundation for future spatial investigations of the city. In addition, they invented or made familiar many of the spatial terms that we still use today to describe urban settlements. Consider, for instance, Burgess's 1925 description of the physical expansion of cities:

> In Europe and America the tendency of the great city to expand has been recognized in the term "the metropolitan area of the city," which far overruns its political limits, and in the case of New York and Chicago, even state lines. The metropolitan area may be taken to include urban territory that is physically contiguous, but it is coming to be defined by that facility of transportation that enables a business man to live in a suburb of Chicago and to work in the loop, and his wife to shop at Marshall Field's and attend grand opera in the Auditorium. (Park et al., 1925, pp. 49–50)

We turn to the definition of *metropolitan area* in Chapter 2, but it is worth noting that this terminology was in use by the human ecology school as far back as 1925. Finally, the human ecology school produced very practical spatial surveys of the city, which helped explain the location of the city's various activities. It is one of the contributions of the Chicago School that would become a major wellspring of the spatial perspective within urban geography. Yeates (2001) also refers to a 1960s Chicago School within the University of Chicago's Department of Geography.

1.7 THE L.A. SCHOOL OF URBAN STUDIES

Recently, a group of urban geographers and affiliated scholars have defined a new urban studies school called the L.A. School (Dear, 2002). Led by geographers Michael Dear, Edward Soja, and Allen Scott, these scholars were for many years resident in the Los Angeles region and used their urban region as a laboratory for many different types of urban investigations. Like their Chicago School predecessors, they argue that their laboratory is the most dynamic metropolis and very reflective of urban processes under way globally (Scott & Soja, 1996). They contend, furthermore, that many of the principles developed by the Chicago School do not pertain to Los Angeles or to the modern-day metropolis in general. Thus, they offer up Los Angeles as the prototype for examining new urban processes—and particularly the impact of globalization.

Among their theoretical points are the following. Postmodern thinking leads to a wide range of methods of gathering knowledge. These include feminism, architectural design theory, postcolonial concepts, and others. In regard to the study of the city, they contend that, rather than having a city with a centralized core, many core functions have moved to the periphery. Accordingly, they see an "undifferentiated, centralized grid" instead of the concentric zones proposed by Burgess. As an explanatory framework, the L.A. School draws on the concept of *keno capitalism,* alluding to the patchwork layout of a keno game board (Dear & Flusty, 2002). The urban zones on the keno board are seemingly random, with a lack of relationship between squares. Both Los Angeles and Las Vegas serve as examples of this keno layout (Dear & Flusty, 2002). The L.A. School has been expounded on at length by its adherents (Dear, Schockman, & Hise, 1996), as well as by its critics. The debate also prompted a response to consider a New York City School of urban studies, one that emphasizes compact urban forms (Halle, 2003).

Recent debate among advocates of the Chicago, L.A., and New York City Schools is taken up in much greater detail with comparisons of the principles and processes espoused by the schools in Chapter 3.

1.8 DATA AND SPATIAL ANALYSIS IN URBAN GEOGRAPHY

Spatial analysis in urban geography emphasizes the spatial relationships of urban phenomena. This perspective gained ground in the 1950s as the social sciences were becoming more quantitative, in a time sometimes termed the *quantitative revolution* (Adams, 2001). The perspective reached full maturity in the early 1970s, as exemplified by the popular geography textbook of the time, *Spatial Organization: The Geographer's View of the World* (Abler, Adams, & Gould, 1971), which laid out many of the principles and methodologies for measuring urban spatial distributions. Increased computing and Internet processing capabilities coupled with web-based access to census data allowed researchers to do more systematic and comparative analyses of city distributions. Today, the spatial analysis approach to urban geography is assisted by the more powerful, contemporary GIS tool, which is described in the next section.

As seen in Table 1.3, the spatial analysis view emphasizes the geographical locations of entities in the city and their relationship to each other. The spatial concepts include size, shape, distance, direction, proximity, intervening opportunity, spatial location, connectivity, optimal pathway, buffering, statistical analysis, and modeling. Buffering refers to putting a buffer zone around a point, line, or polygon. For instance, an urban geography study might be analyzing a major highway, represented by a line, which has a 100-yard buffer zone on either side that represents the limit of tolerable residential noise impacts. Spatial analysis compares the shapes, sizes, and juxtaposition of points, lines, and polygons, often overlaying layers of spatial features. Statistical analysis examines how correlated distribution of one characteristic is with that of another or applies cluster analysis techniques to group together spatial locations having similar characteristics. Spatial techniques and data allow three-dimensional (3-D) spatial analysis, for instance, of human settlement patterns in a hilly region. They also support the time dimension, so maps can be produced in sequence—for example, producing a visual sequence of monthly spatial patterns of unemployment in a city.

There are today vast amounts of spatially referenced data available and inexpensive GIS tools to analyze the data. Spatial data are increasingly gathered and utilized by national censuses; other agencies of national, state, and local governments; international organizations such as the United Nations; and market research and other information-gathering corporations. Because the trend in government and industry is to gather growing amounts of spatial data, the spatial approach has great promise for the future.

An example of the approach is a city feature map of El Paso, Texas (see Figure 1.12). El Paso is a large city in the southwest corner of Texas just north of the Rio Grande River. As seen in the figure, the city has a diagonal urban footprint that runs from northwest to southeast, mostly along the U.S.–Mexican border (shape). The figure shows the three bridges that connect El Paso with the larger city to the south (direction, proximity) of Ciudad Juarez, Mexico. The CBD is one kilometer from the Stanton Bridge border entry to Mexico (i.e., this demonstrates distance). The U.S. Interstate Highway 10 is the thick line that runs just north of the CBD (proximity). El Paso Street runs from the downtown to the most easterly bridge, whereas

TABLE 1.3 Spatial Analysis Components

Spatial Concept	Meaning	Example of Its Use
Size	Spatial size of a feature	The land area of the city of Chicago
Shape	Shape of a feature	The shape of the Tokyo metropolitan area
Distance	Distance between features	The distance between the city centers of St. Louis and Pittsburgh
Direction	Direction of the processes between features	The direction of suburban growth 2000–2010 in Seattle
Scale	How big or small a map is relative to the real world	1 inch on the map of Los Angeles represents 50,000 inches on the ground
Contiguity	Closeness of one feature(s) to other feature(s)	The closeness of the 10 Freeway in the city of Los Angeles to primary schools
Intervening opportunity	Map feature(s) that affects processes between a sending and receiving feature	The flow of migrants between southern Mexico and the United States is reduced by employment opportunities in the Mexican cities in between
Optimal pathway	The optimal pathway between two or more features	The shortest route in distance for a truck traveling between Long Beach, California, and Bakersfield, California
Buffering	A zone at a certain distance surrounding a feature	The zone of 2,000 feet surrounding Central Park in New York City
Statistical analysis	Statistical analysis of attributes of a feature	The correlation of the total population to the unemployment rate for cities in England
Modeling	Modeling of the attributes of features	A model to predict the ethnic changes from 2010 to 2020 in the neighborhoods of Houston, Texas

Source: Modified partly from Clarke, K. C. (2010). *Getting Started with Geographic Information Systems* (5th ed.). Upper Saddle River, NJ: Prentice Hall.

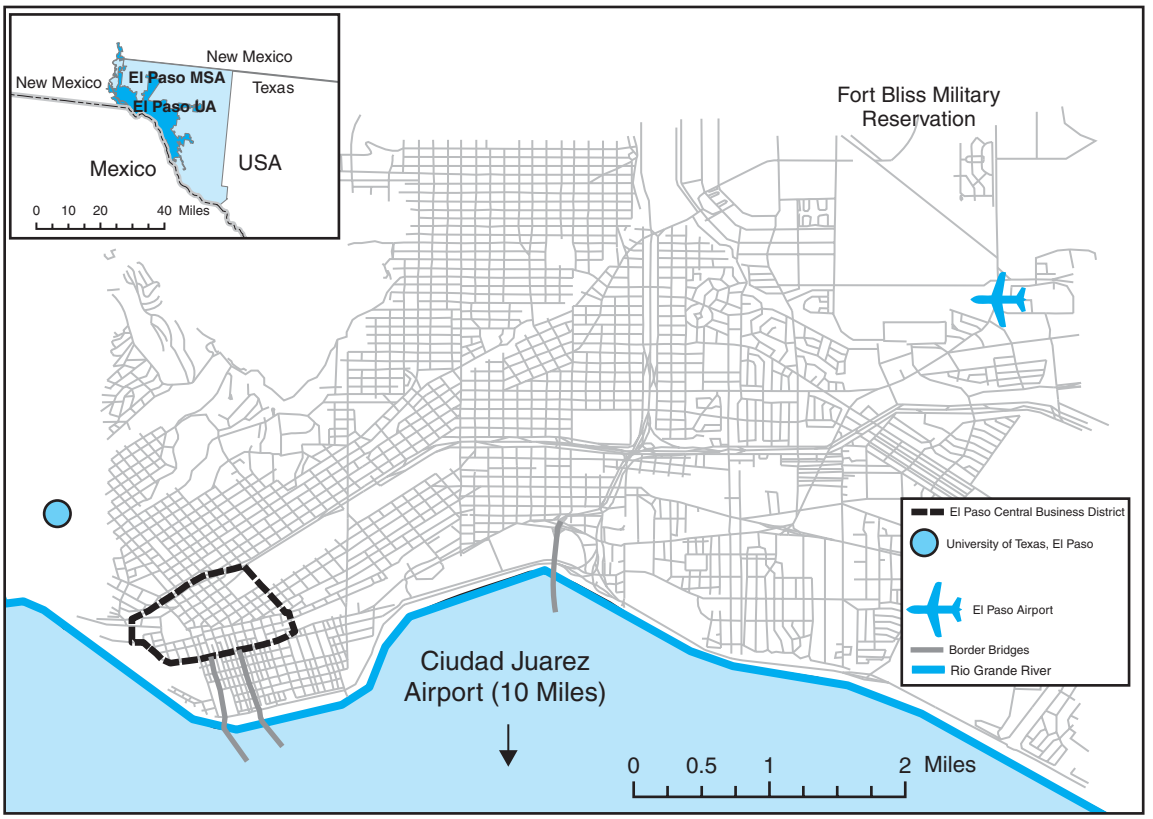


FIGURE 1.12 El Paso urbanized area, metropolitan, and city features.

Stanton Street runs from the CBD into the next Stanton Bridge to the east. The University of Texas, El Paso campus is located to the northwest, near the CBD (i.e., proximity). Military installations are to the north and northeast of the CBD (direction).

As shown in the figure inset, the urbanized area (UA) of El Paso (i.e., the area within the urban boundary, as defined by the U.S. Census Bureau) is 300 square miles, but the El Paso Metropolitan Statistical Area (MSA) corresponds to El Paso County, which is 1,013 square miles (i.e., size). Both sides of the border are interconnected through border transport and commerce (connectivity). Although not illustrated on the map, the fastest vehicular route at a particular hour between the El Paso airport and the Ciudad Juarez airport can be identified and its transit time estimated. However, because of deteriorating public safety in Ciudad Juarez, that route might not be a safe one. Although simplified here, this approach provides insight into the urban context of this border city.

1.9 ALTERNATIVE APPROACHES TO URBAN GEOGRAPHY

Spatial analysis is not the only approach in use today for urban geography. Another is the *political economy approach,* which stresses the importance of political and economic institutions and processes in shaping city form and urban experience. It considers, for example, how the locations of corporate headquarters, factories, and distribution centers impact local economies and how changes in political processes and the structure of local government affect city planning. The political economy approach is emphasized in this book, especially in Chapter 8 on industrial location, Chapter 9 on urban fringe growth pressures, and Chapter 11 on urban planning. Although less frequently employed for this purpose, the GIS can be used to model political and economic institutions and processes. An example is the widespread use of GIS analysis for political campaigning in the United States. The political economy approach can also come into play in interpreting the urban and metropolitan spatial patterns modeled in a GIS.

Other approaches to urban geography include the behavioral, urban economics, and urban history approaches. The *behavioral approach* emphasizes urban decision making in a social psychology framework. For instance, the stress levels of residents of downtown Cleveland can be compared to those levels in suburban residents. Cadwallader (1996) introduced the application of the behavioral approach in urban geography with the concept of the *city of the mind,* which is defined as how residents of the city perceive the structure of the city. Cognitive maps or mental maps are an added feature of the approach, as Duncan (1987) argued that people frequently call on their mental maps of the city, which in turn influence their behavior in the city. The ramifications of this approach are far-reaching, as there are many perceptions of the city contained within a single city, and these perceptions serve as the basis for behavior. Cadwallader's (1975) study of consumer behavior in West Los Angeles is illustrative of the approach. The study addressed a classic assumption of retail geography: that consumers are rational in their patronage of retail outlets that are nearest to them. Cadwallader found that consumers thought they were rational with respect to the generally accepted retail law, yet in practice they did not always observe it. The conclusion, then,

was that these consumers obeyed the law in terms of cognitive distance, but not in terms of physical distance.

In the *urban economic approach,* economic concepts are applied as a way of explaining spatial variation in economic phenomena such as land rents and industrial location. An example is the effect of the 2007–2009 Great Recession in the United States on the spatial pattern of housing foreclosures in Phoenix. In addition, many *urban historians*—especially those addressing changes in the built environment or in industrial locations—find a welcome home in urban geography. Consider, for example, the task of explaining changes over the past 50 years in the spatial patterns of ethnic groups in the Los Angeles urban area. An urban historian might examine ethnic distributions in the context of the California economy's ups and downs during the past half-century, U.S. immigration regulations and policies, the politics of neighborhoods, neighborhood changes, housing, and jobs.

More perspectives of urban geography were developed in the 1980s. Knox (2003) noted that increasing globalization of the economy during the 1980s expressed itself spatially through networks of cities. Knox observed that the response by geographers was toward broad frameworks of inquiry such as structuralist theory, exemplified by Harvey's (1989) *The Condition of Postmodernity* and Soja's (1989) writings in social theory. Today, postmodernist geographers emphasize the complexity and ambiguity found in urban land-use patterns (Hutton, 2004). Additionally, Knox (2003) suggested that urban geographers were engaged with other social science disciplines in the development of social theory, citing specifically Giddens (1984), a sociologist who also developed a structuration theory centering on time and space.

All of urban geography's traditions flourished in the 1990s (Hanson, 2003). The spatial analysis tradition continued alongside further advancements in social theory (see Table 1.4). Hanson (2003) analyzed urban geography articles published in the 1990s in three of the discipline's major journals and found that tradition prevailed:

> A substantial proportion of articles take[s] up topics with lineages that stretch back to the Chicago School of urban sociology in the 1920s: immigration, residential segregation by race and class, urban spatial structure, the impact of neighborhood context on households and individuals. Another sizeable group of papers emphasize[s] flows (of people, goods, ideas, and above all money) both within settlements and between them and the ways in which longer-distance flows embed a place in a network of linkages and shape the urban system. Interest in such flows in urban geography also dates to the 1920s (e.g., Platt, 1928). At the intra-urban scale, many articles continue to focus on a particular type of flow—the journey to work, which owes its debut as a star in urban geography to neoclassical urban economists Alonso (1964) and Muth (1969). (Hanson, 2003, pp. 467–468)

Hanson (2003) concluded that important topics such as urban environment, sustainability, identity, and megacities of the developing world deserve greater attention in the future, principally because such research could yield practical solutions for our increasingly urbanizing world.

TABLE 1.4 Themes in Urban Geography Literature, 1990s

Category	Percent
Segregation (including housing, immigration, labor markets, gentrification)	26
Overviews and theoretical perspectives	10
Flows (e.g., airline flows, commuter flows, migration, business linkages)	9
Gender	9
Politics (e.g., NIMBYism, activism, gerrymandering)	9
Globalization (e.g., of labor, capital)	8
Location of economic activity (retail, manufacturing, services)	8
Urban spatial structure (e.g., rural–urban boundary, suburbanization)	8
Urban image (representations of specific cities)	4
Nature/urban environment (water, chemical hazards, topography)	3
Policy evaluations (e.g., banking deregulation, protection of agricultural land)	3
Culture (e.g., cultural practices, understandings of place)	3
Third World cities/megacities	1

Source: Hanson, Susan. (2003). "The weight of tradition, the springboard of tradition: Let's move beyond the 1990s." *Urban Geography* 24:465–478. Table 1, "Themes in urban geography literature, 1990s: Proportion of articles in each category," p. 467.

Latham, McCormack, McNamara, and McNeill (2009) have identified the following key concepts and subconcepts in urban geography: (1) *location and movement* (centrality, mobility, global cities, transnational urbanism), (2) *constructions* (nature, materiality, infrastructure, architecture), (3) *envisioning and experience* (diagram, photography, body, virtuality, surveillance), (4) *social and political organization* (segregation, urban politics, community), and (5) *sites and practices* (consumption, media, public space, commemoration). The concepts include global and technology components that align with some of the book's contents.

1.10 THE APPROACH OF THE BOOK

This book provides a contemporary overview of urban geography, including a mixture of traditional and contemporary topics. The book emphasizes the important concepts and theories of urban geography, including new ones. Google Earth and ArcGIS are used as urban analysis tools to reinforce urban geography principles. Each chapter has an "Analyzing an Urban Issue" section that is tied to Google Earth and ArcGIS exercises at the end of the chapter. This hands-on approach emphasizes contemporary technology and tools used by urban planners to solve everyday problems.

The book is divided into several sections. The first chapter is introductory and includes fundamentals of the discipline, approaches, and concepts of urban geography. Chapters 2, 3, and

4 define the city, urban area, and metropolis; examine the internal structure of cities; and consider differences among systems of cities. Chapters 5, 6, and 7 cover interrelated topics of neighborhoods, residential mobility, migration, race, ethnicity, and poverty. Linkages of these topics include, for instance, the influence of residential mobility on changes in neighborhoods, migration and ethnicity, and ethnic neighborhoods. Chapters 8 and 9 have an economic focus on industrial locations in various parts of cities, the urban core, and edge cities as more peripheral service centers. Chapters 10 and 11 discuss the related topics of the urban environment and urban and regional planning. Environmental issues can often be mitigated through improved planning and regulatory processes. Chapter 11 also serves as a capstone, bringing together concepts from all the prior chapters and integrating them in planning principles and case studies. This last chapter discusses major challenges for cities in the 21st century, achieving smart growth, downtowns, city governance, technology, and urban areas in the developing world.

In its more detailed contents, this first chapter introduces the student to the field of urban geography and to the spatial approach to the subject. It discusses Google Earth and ArcGIS, as well as how a GIS can be applied to urban geography. It also includes a section entitled "An Introduction to GIS and Spatial Analysis Principles," which provides a concise foundation for the lab exercises.

Chapter 2 introduces simple city concepts and then looks at the definitions of city, urban area, urbanized area, and metropolitan area. The metropolitan definitions are extended to the megacity. Chapter 3 is concerned with the internal structure of cities—in particular, the demographic and economic dynamics of cities and urban areas inside their boundaries. Population distribution and land use patterns are described. Starting with classical theories of population density and models of urban structure, the chapter considers the major models of concentric zones, sectors, and multiple nuclei. Alternatives to the classical models are introduced, with an expanded section on the new L.A. School. In its "Analyzing an Urban Issue" section, the population density distributions of Los Angeles and Chicago are compared over a 40-year period, and density gradient models are constructed for Mexico City. An example of a city core is downtown Barcelona, Spain, shown in Figure 1.13. Chapter 4 reviews the systems-of-cities approach to urban geography, including central place theory, the evolution of the American urban system from 1790 to today, global cities, and the issues of changes in China's modern urban system.

Chapter 5 introduces neighborhood concepts such as definition, change, and composition. Neighborhood topics include gated communities, gentrification, historic preservation, streetcar suburbs, and neighborhood racial composition. The urban issue analyzed is neighborhood transitions in the city of St. Louis. Also covered are gentrification, activism, and impacts of the U.S. recession and housing crisis of 2007–2009. Chapter 6 examines concepts and models of migration and residential mobility, including factors in migration, rural-to-urban migration, and residential mobility and its causes. An example of the huge impact of in-migration on urban areas is the vast migration to Florida in the 1990s and early 2000s. Besides migration, the state's population changed by the difference of births minus deaths. This put pressure on urban systems from water supply to administration to voting. The 2000 U.S. presidential election raised voting system problems within counties and statewide in Florida, and voting problems continue to affect some elections in certain districts. The chapter also covers directional bias (i.e., tendencies of people in cities to move residentially in certain directions) and international immigration.

Chapter 7 introduces the topics of gender, race, ethnicity, and poverty as common characteristics of cities in the United States and worldwide. For instance, in Los Angeles recent data show that Hispanic and Asian ethnic distributions grew and shifted in a major way in the 1980s and 1990s, whereas non-Hispanic Whites decreased and Blacks were unchanged. Further, poverty is high on the periphery of Latin American cities, but people in these zones can escape poverty through better education, jobs, and home improvements. The chapter also addresses how to measure ethnicity and poverty, ethnic hot spots in the suburbs, gender, racial segregation, the urban ghetto and underclass, and poverty in *colonias* in the Mexican border region.

Chapter 8 concerns industrial location. Today, businesses have a wide choice of places in which to locate, from the classical CBD to shopping malls, industrial parks, and the urban fringe. The reasons why industries locate in particular places are discussed. The chapter covers the concepts of industrial classification, location theories, location quotient, and the geography of consumer and producer services. Mexico's *maquiladora* industry illustrates binational industrial location, and the U.S.–Mexican border cities demonstrate border consumer interactions.

Chapter 9 looks at the issue of urban core versus edge cities. As the urban cores of many U.S. cities have deconcentrated, more population has settled in often peripheral communities of metropolitan areas, referred to as edge cities. For instance, west of Chicago, Hoffman Estates, Schaumburg, and Naperville are examples of edge cities. They are tied to the metropolitan area and yet sometimes occupy land in the hinterland. This leads to pressure on the urban fringe and "leapfrog" development, in which formerly rural locations on the metropolitan periphery become urbanized. Fringe growth is taking place not only in every U.S. metropolitan area, but also in all developing world cities, such as Delhi and Mexico City. Other chapter topics are urban sprawl and smart growth, which is a planning approach to reducing the adverse effects of sprawl.

Chapter 10 emphasizes that urban areas often grow beyond their capacity to control or even monitor environmental degradation. There are many horror stories of environmental neglect, ranging from the notorious Love Canal case of toxic waste emission to Mexico City's air pollution. With a geographical approach, urban environmental problems such as land use, water resources, flooding, solid wastes, energy supply, and air pollution are examined. Environmental justice perceives unevenness and often unfairness in the patterns of places and groups impacted by the environment.

Chapter 11, on urban and regional planning, examines the history of urban planning, starting in London in the 17th century and extending to today's planning challenges in the United States and China. It looks at how planning is achieved or not achieved, how to renew or improve central downtowns, and

FIGURE 1.13 Overview of downtown, Barcelona, Spain.

how to implement new types of planning to include smart growth, restoration of downtowns, and open spaces. Planning in the developing world often relies more on politics and influence and less on objective methods. The challenge of technology is considered for cities and broader urban geographies. Several case studies are presented, including the challenges of planning in increasingly built-up Shanghai, seen in Figure 1.14.

Accompanying each chapter in the text are Google Earth and ArcGIS lab exercises. The exercises cover such topics as density mapping and density gradients (Chapter 3), centrographic analysis of segregation (Chapter 7), and analysis of land use conversion (Chapter 9). The examples are drawn from cities that range in size from megacities, including Tokyo, to large and medium-sized cities, such as Dallas and Springfield, Missouri. The intent of the lab exercises is to have students reinforce their learning of urban concepts and principles by practicing with real-world data and problem solving. Google Earth can be downloaded and installed from Google's webpage. The .kmz files for the Google exercises are available on the Prentice Hall book website. The GIS software is ArcGIS from Environmental Systems Research Institute (ESRI), Inc. The exercise files for both ArcGIS 10 and ArcGIS 9.3 are available on the Prentice Hall book website. For two of the exercises, Microsoft Excel is also utilized.

The exercise data are drawn mostly from current censuses and other government sources. The initial knowledge of computing software called for is rudimentary, but students will be expected to learn some GIS and spreadsheet skills. The emphasis of the labs is not on mastering all the package commands. Students who would like to master the software packages are advised to obtain additional training from seminars, courses, and online tutorials.

The labs complement the textbook readings and lectures, leading to a balanced and contemporary learning approach. As noted earlier, each chapter has a section titled "Analyzing an Urban Issue" that is tied to the lab exercise topic for that chapter. These issue discussions will provide ample background for students to answer questions and write short essays after completing

FIGURE 1.14 Shanghai, China. *Source:* J. Pick.

the exercise. In this chapter, we have explored the issue of Sunbelt city growth, and that topic is the focus of the GIS exercises. We advocate an integrated learning approach, which might also include field trips to accessible urban areas and work on the World Wide Web to acquaint students with local, regional, national, and global urban geography data, reports, issues, problems, and solutions.

In summary, Urban geography is important because it involves concepts and issues of profound significance for business, commerce, government transportation, the environment, and daily life. Its field is cities and urban areas and how they are organized and function. The major perspectives in urban geography are economic, social, cultural, human, environmental, and physical. The allied disciplines of urban sociology, political economy, and others are often useful. This book emphasizes the spatial approach. The modern GIS tool encompasses the geographic boundaries and multiple dimensions of attributes of cities and urban areas.

Students using this book will learn about diverse aspects of urban geography, including population distribution and land use, neighborhoods, race and ethnicity, gender, industrial location, migration, the internal structure of the metropolis, edge cities, environment, and urban planning. The main text provides the concepts, discusses examples and applications, and considers the implications for business and society. The Google Earth and ArcGIS exercises offer hands-on practice in urban analysis that helps the student to analyze city processes and see how their problems can be solved.

1.11 URBAN ANALYSIS USING GOOGLE EARTH

Google Earth is a three-dimensional geographic data and map viewer produced by Google Inc. The program is best known for providing lifelike views ranging from urban landscapes to rugged natural landscapes through the usage of terrain models and aerial photography. Google Earth was introduced in 2005 and has become one of the dominant spatial viewers. KML (Keyhole Markup Language) and KMZ (compressed/zipped KML) files serve as Google Earth's macro language that executes a preset sequence of Google Earth commands. KML is an XML-based language and Open Geospatial Consortium standard.

Google Earth differs from Google Maps in that it is a standalone program that the user downloads, rather than being solely a website viewed through a web browser. Google Earth, seen in Figure 1.15, allows users to easily load KML files, choose data layers to display, and view terrain and buildings in 3-D. Google Earth and Google Maps share aerial and street-level imagery.

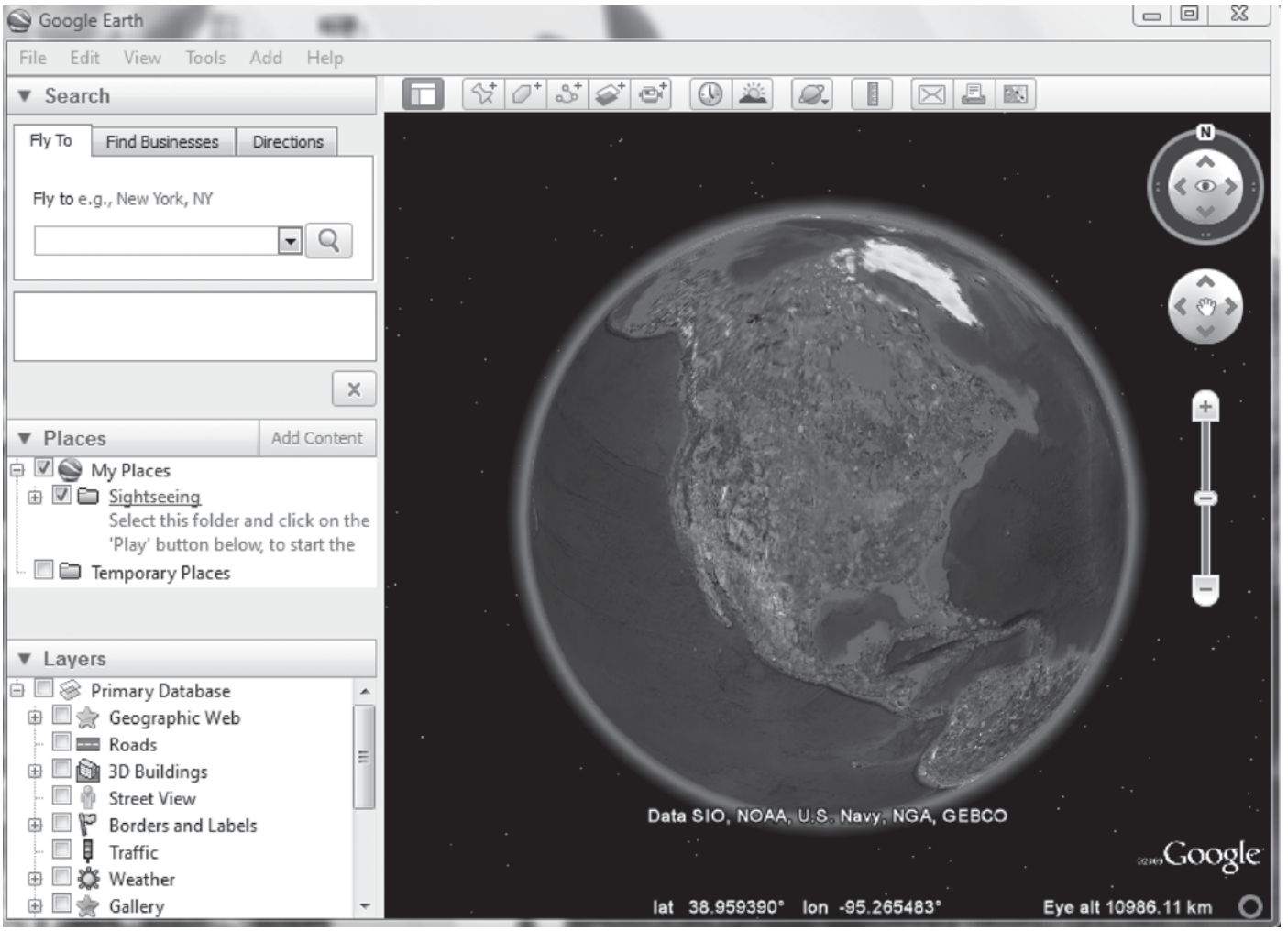


FIGURE 1.15 Google Earth screenshot.

Google Earth is now being utilized by the mainstream media to convey geographic information during television broadcasts. Google Earth has also entered the classroom as a tool in teaching physical and cultural geography. This textbook uses Google Earth to convey GIS concepts and methods without the cost and training associated with GIS software.

However, since Google Earth is a data viewer, it does not have the complex analytical tools that are present in GIS software. Google Earth does allow for the visualization of spatial patterns and the exploration of landscapes. Google Earth's user interface has similarities with most traditional GIS software. The right pane of the window displays map data and aerial imagery, while the left pane includes a search box and lists a variety of data sources. A toolbar at the top of the window allows the user to change views, make measurements, and share a map through e-mail.

The map window includes tools for zooming, panning, rotating, and tilting the view. The tools are located at the upper-right corner of the map window. The compass located at the top of the navigation tool cluster rotates and tilts the map. The second tool down pans across the map. The bottom tool adjusts the zoom level. The rotate and zoom features are shown in Figure 1.16. There are keyboard shortcuts and mouse gestures that can be used in lieu of these tools. For example, left-clicking on the map and moving the cursor is equivalent to using the panning tool. The keyboard's arrow keys can be used for panning as well. The scroll wheel on certain mice can be used to zoom in and out on the map; the plus and minus keys on the keyboard also work for zooming. Should a user become disoriented, pressing the R key will reset the map so north is at the top and the view is perpendicular to the ground.

The left pane of the Google Earth window is broken into three sections—Search, Places, and Layers (Figure 1.17). The Search section of the left pane is used to search for places on the

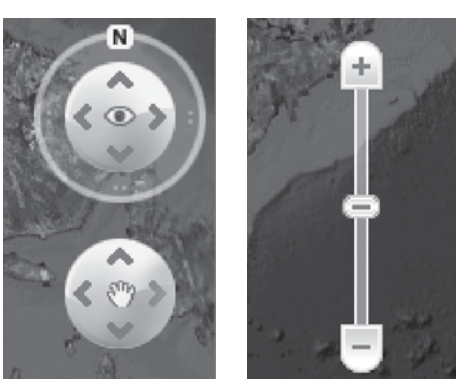


FIGURE 1.16 Google Earth rotate and zoom tools.

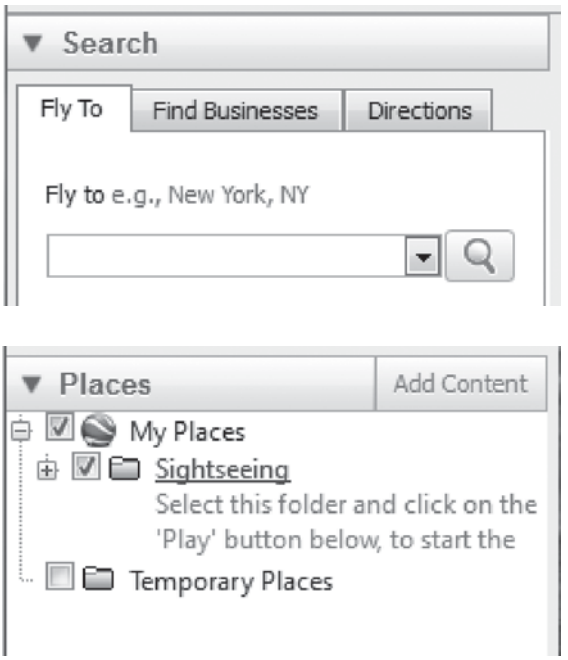


FIGURE 1.17 Google Earth screenshots of Search, Places, and Layers.

map, such as addresses, businesses, cities, and airports. Search results are returned to this section of the display, and the corresponding points are shown on the map.

The Places section lists geographic data that have been added or saved. The check boxes allow the user to choose which data layers to display on the map. Some items in the list of data layers have a plus symbol next to them. This means the item in the list can be expanded to see more data layers that are available for display.

The Layers section offers the user a wealth of free data to display on the map. It is functionally similar to the Places section, but the data listed here are provided by Google or its partners. Roads, cities, parks, transportation hubs, businesses, and other of points of interest are available for display.

The Layers section also includes StreetView, which consists of street-level photos taken by specially equipped Google vehicles. Street View is triggered by dragging the Street View man icon onto streets that are highlighted in blue. To navigate on a street in Street View mode, you can double-click somewhere down the street to move, or use the scroll wheel on the mouse. A street view of a Chicago neighborhood is seen in Figure 1.18. Using the rotate and zoom tools, the user can pan 360° around the scene, and can look up and down.

The 3D Buildings layer allows you to see three-dimensional renderings of buildings in urban areas around the world. For

North Dearborn Street / West Delaware Place
Exit Street View
West Delaware Place
© 2010 Google
© 2010 Google
Google
Report a problem
41° 53.955' N 87° 37.751' W elev 611 ft
Eye alt 597 ft

FIGURE 1.18 Google Earth street photograph.

Gray Buildings © 2010 CyberCity
Gray Buildings © 2008 Sanborn
Image NOAA
lat 41.883908° lon -87.630417° elev 248 ft
©2010 Google
Eye alt 2238 ft

FIGURE 1.19 Google Earth aerial imagery.

instance, Chicago's Loop, including the 108-story Willis Tower (formerly Sears Tower) in the lower center, is seen in 3-D in Figure 1.19. Some locations show only gray cubic structures, but other areas show photo-realistic façades draped over geometrically accurate representations of the building.

Google Earth has the ability to view historical aerial imagery for locations. Clicking the clock icon will open a time line, as seen in Figure 1.20 . Clicking the forward and back buttons above the time line or dragging the slider bar will display the aerial imagery available for the time selected on the time line. The measure tool, which looks like a ruler and is seen in Figure 1.21, can measure distance. Different units can be chosen on its menu such as meters, kilometers, or miles. Further information about using Google Earth is available from the software program's Help menu.

1.12 GEOGRAPHIC INFORMATION SYSTEMS

GIS utilizes specialized software to analyze problems spatially. It is difficult to say when the first GIS was introduced. One could argue that the manual map overlay procedure for land

FIGURE 1.20 Google Earth clock and time line icons.

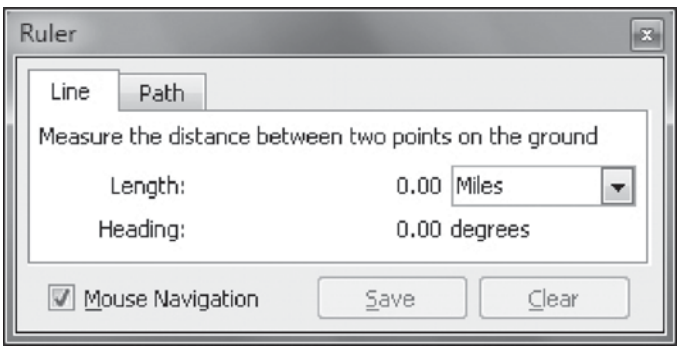
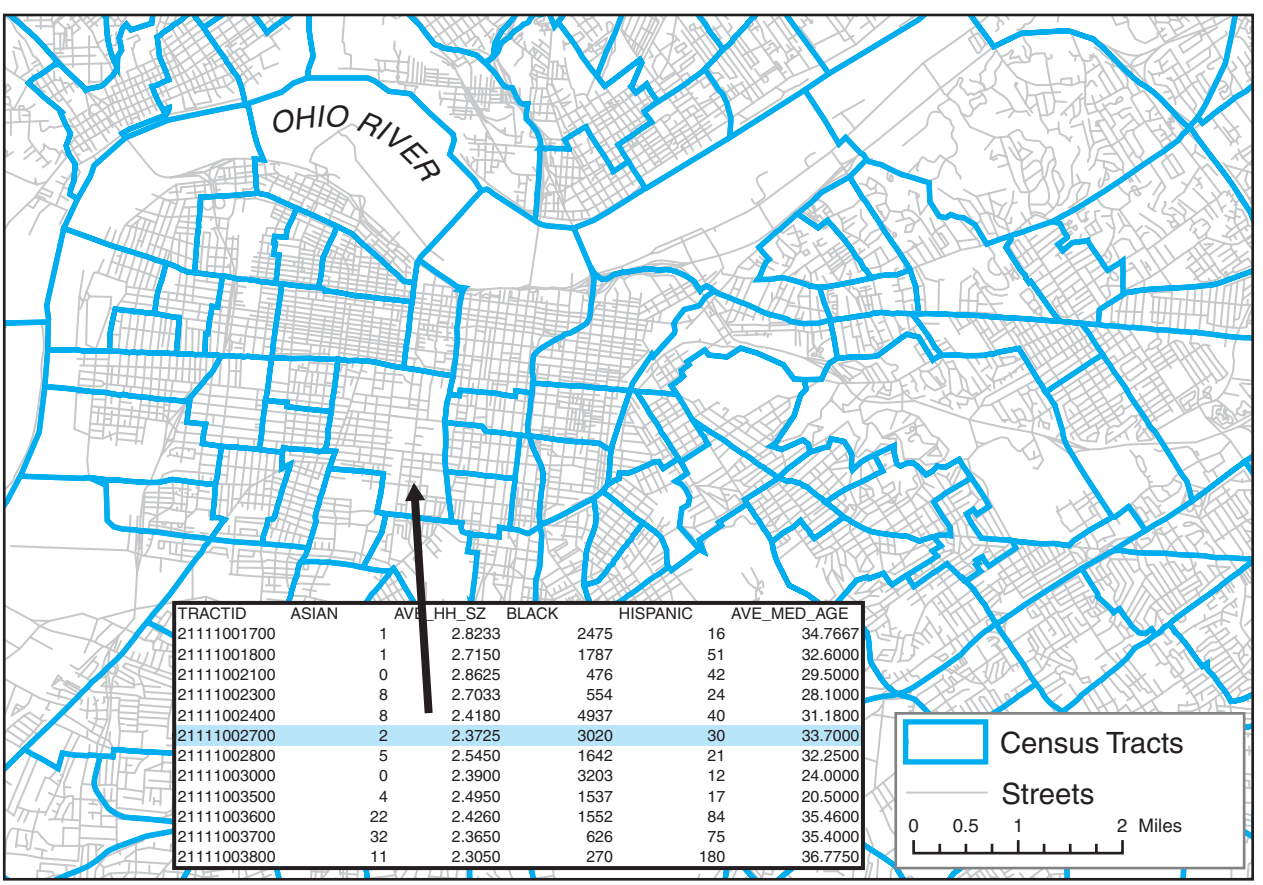


FIGURE 1.21 Google Earth measure tool.

suitability studies advocated by McHarg (1969) in *Design with Nature* was a GIS in principle (Clarke, 2010). Early computer programs for GIS were introduced in the United States in the late 1950s by the U.S. Census Bureau (Clarke, 2010) and in Canada in the 1960s to map natural resources. Since the 1960s, the use of GIS has grown as a field, at first expanding in the government sectors in the United States and Canada, especially in local and regional governments. Today, GIS is routinely applied by city, county, and state governments in the United States, Canada, and Western European and other advanced nations. It is catching on with governments in the developing world, but might need another decade to be widely utilized there. GIS use also is spreading rapidly in the business world, which uses it for marketing, logistics, transportation, siting, real estate, and natural resource exploration (Pick, 2008).

The components of a GIS are the *database,* containing the attribute data; the *boundary files,* containing the geographic coordinates for *digital map layers; analysis tools;* and a *user interface,* enabling the user to utilize the software readily.

The database contains attribute information, which is associated with geographical features that are points, lines, or polygons. An example of a polygon feature is Census Tract 21111002700 in Louisville, Kentucky, shown in Figure 1.22. A *census tract* is a small area of a county defined for publishing census data. Tracts average about 4,000 inhabitants and are fairly consistent internally in their demographic characteristics. Examples of census tracts are shown for Louisville, with the following characteristics given: number of Asian residents, average household size (AVE_HH_SZ), number of Black residents, number of Hispanic residents, and average median age (AVE_MED_AGE). Census Tract 21111002700 has 2 Asian, 3,020 Black, and 30 Hispanic residents. The tract's average household size is 2.4 and its median age is 33.7. An arrow in Figure 1.22 points to that tract, which is part of a digital map layer consisting of dozens of census tract boundaries. The layer



TRACTID	ASIAN	AVE_HH_SZ	BLACK	HISPANIC	AVE_MED_AGE
21111001700	1	2.8233	2475	16	34.7667
21111001800	1	2.7150	1787	51	32.6000
21111002100	0	2.8625	476	42	29.5000
21111002300	8	2.7033	554	24	28.1000
21111002400	8	2.4180	4937	40	31.1800
21111002700	2	2.3725	3020	30	33.7000
21111002800	5	2.5450	1642	21	32.2500
21111003000	0	2.3900	3203	12	24.0000
21111003500	4	2.4950	1537	17	20.5000
21111003600	22	2.4260	1552	84	35.4600
21111003700	32	2.3650	626	75	35.4000
21111003800	11	2.3050	270	180	36.7750

FIGURE 1.22 Louisville census tracts and associated attributes. *Source:* U.S. Census, 2010.

can be regarded as a set of boundaries, without the attribute information, whereas the attribute information is contained in an associated table. Census tracts together constitute a county, metropolitan area, or state.

One basic purpose of a GIS is to present the data in understandable maps. However, an even more important purpose is to perform types of spatial analysis based on the map data. The analysis might consist of comparing two maps, measuring the areas of ZIP codes, determining the fastest transportation route between two points, analyzing neighborhood change, or graphing political opinion by city ward. GIS spatial analysis tools include distance measurement, buffering, statistical, overlay, drawing, and 3-D visualization tools. A simple measurement tool is the ruler that enables measuring the distance between two points. The buffering tool allows you to measure how many mapping items are within a "buffer" distance from a line or polygon. Statistical tools allow you to calculate means, standard deviations, correlations, regressions, cluster analyses, and other functions. For example, if you have a section of Cincinnati containing 50 census tracts, you can employ this tool to calculate the average income for all the tracts or the maximum percentage of the workforce that is employed among all 50 tracts. You can also correlate crime and retirement population for the tracts. The overlay tool allows you to superimpose one digital map layer over another. In the example shown in Figure 1.23, Chicago's commuter rail system (layer 1) is superimposed on its population density (layer 2). Overlaying gives insights that neither layer by itself provides. The map shows a strong relationship between the commuter rail lines and high population density.

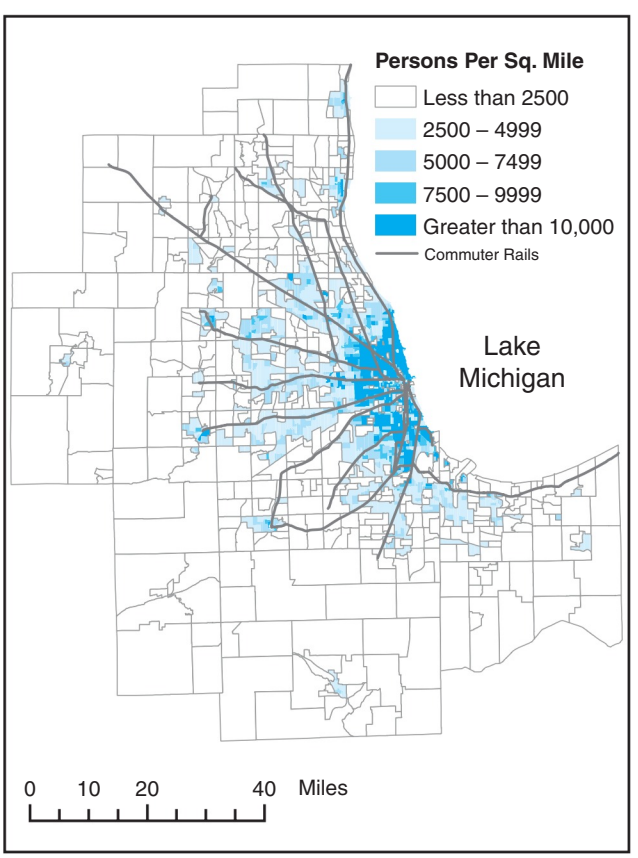


FIGURE 1.23 Overlay of Chicago's commuter rail system with year 2000 population density.

There are numerous other tools available. For instance, ArcGIS, the GIS software package utilized for this book's exercises, includes over a hundred analysis tools.

Today's GIS software is user-friendly and visually appealing. Modern user interfaces offer easy-to-use features with buttons, menus, and click options to manipulate the maps and launch the spatial analysis tools discussed in the chapter (see Figure 1.24 for the interface for ArcGIS). Section 1.14 provides a more in-depth introduction to GIS principles.

In summary, GIS is an exciting contemporary tool for spatial analysis and mapping. It is now in widespread use for urban analysis, business decision making, and a multitude of other applications in advanced nations and is expanding in developing countries. It offers digital map layers, databases, and a variety of tools to manipulate them.

1.13 URBAN ANALYSIS USING GEOGRAPHIC INFORMATION SYSTEMS

The GIS is a helpful tool to apply in urban geography. Data are widely available through government, business, and nonprofit sources. The data range from broad, macro-level data to small-area data and point-location data, such as data for census tract and block units or for individual survey respondents. Digital mapping files are readily accessible for states, counties, metropolitan areas, cities, and special regions such as watersheds, pollution control zones, voting districts, school districts, and transportation corridors. These are sometimes also referred to as *boundary files, shapefiles,* and *coverages*—and in ArcGIS as *map layers or feature classes in a geodatabase*.

Websites such as the following can yield a large variety of attribute information and mapping layers: U.S. Census Bureau at http://www.census.gov ESRI, Inc., at http://www.esri.com U.S. government maps and data at http://www.geodata.gov and U.S. Geological Survey (USGS) national and international maps at http://seamless.usgs.gov.

GIS can be applied to solve urban problems. In government, it is applied for population, taxation, zoning, and tax record analysis; for public health planning; and for many other purposes. Businesses solve urban problems through analyzing urban markets, transportation, product distribution networks, site locations, and utility flows (Pick, 2008). Likewise for students, desktop, laptop, and mobile GIS tools provide an excellent way to practice solving urban problems.

The advantages of a GIS for urban problem solving include improved and more efficient financial management, welfare services, public health, revenue collection, vehicle fleet management, fire and police services, election redistricting, and city and regional planning (Nyerges & Jankowski, 2009). The GIS can view spatial change within cities, which is important because they are dynamic entities. It can easily support very large and complex data sets, which enables such features as small-area analysis. It can also impose modeling features for urban problems. For instance, a GIS can support a density-gradient model and map the results.

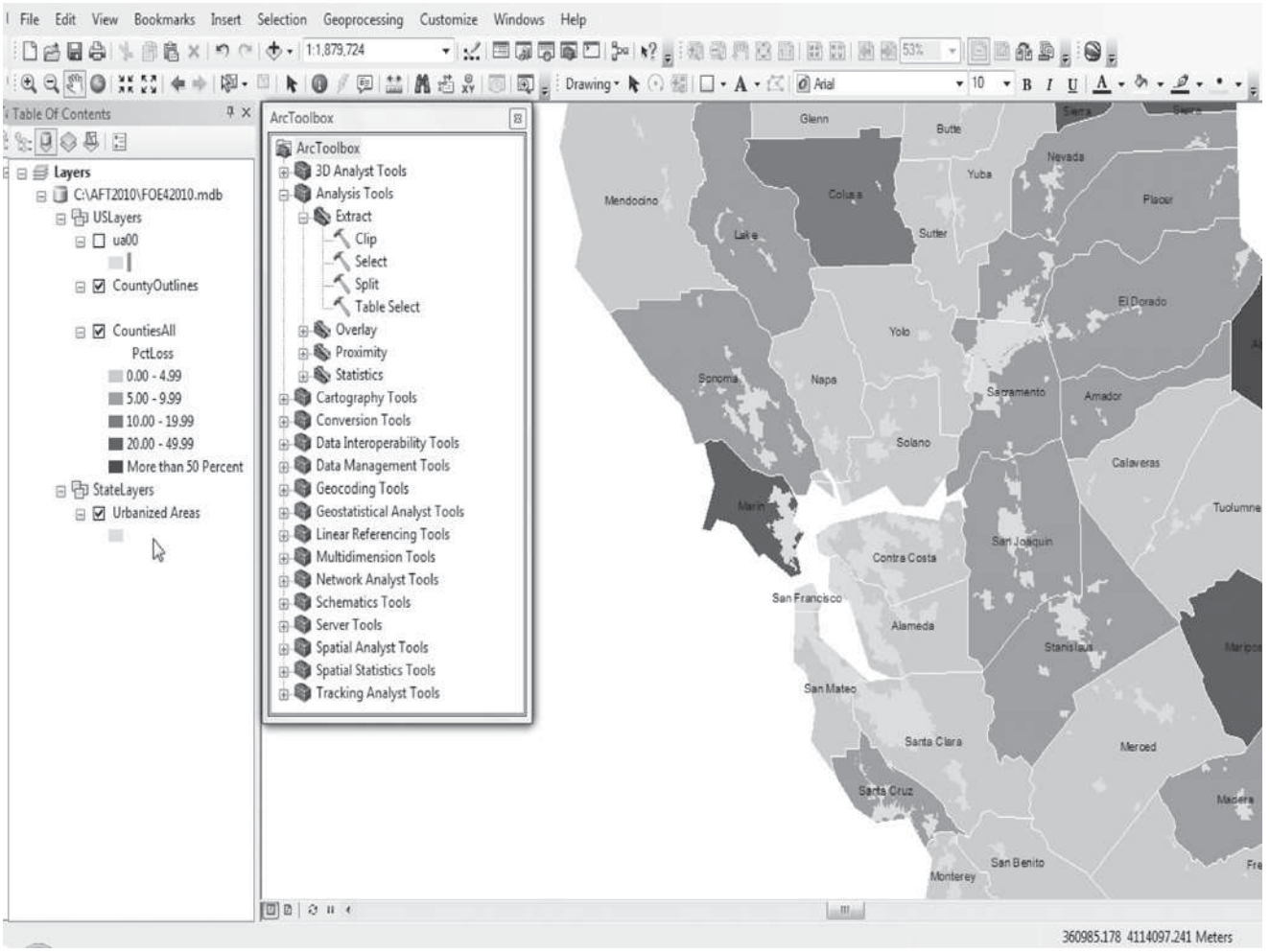


FIGURE 1.24 ArcGIS software interface.

GIS is becoming more widely available to urban practitioners. For instance, most urban U.S. counties have GIS capabilities. The GIS unit might be located in planning, economic development, taxation, finance, environment, health, or other offices. GIS is also used by nonprofit organizations concerned with urban problems, such as New Jersey Geographic Information Network, which is a gateway to GIS information for New Jersey and includes many urban dimensions. In the business sector, varied firms dealing with urban problems use GIS. Cal Atlas Geospatial Clearinghouse (2010) provides government maps and information for California at the state, county, and municipal levels; urban maps can be viewed or downloaded. CH2M Hill, a multifaceted environmental consulting firm in Englewood, Colorado, has developed powerful GIS applications for city and county sewage waste management planning in Los Angeles, Honolulu, and elsewhere, although these maps are not publicly available.

The use of GIS by the Village of Hoffman Estates, Illinois, in metropolitan Chicago, illustrates how a GIS gets introduced to local government and evolves into a fully integrated information system employed by all departments throughout the large suburb. Hoffman Estates is an *edge city,* a type of office-based city located on the outskirts of a metropolitan area, as discussed in Chapter 9. In the first phase of its GIS development, the Village of Hoffman Estates decided to digitize (i.e., convert to computerized form) its property parcel map and to link the county's tax assessment file, containing property owner information such as the street address, to the digital property map (see Figure 1.25). The property map is registered to a highly accurate aerial photo for the region, which serves as the base map to which future map layers will be registered (i.e., fitted exactly when placed one on top of another).

In the second phase of its GIS development, the village implemented a notification application allowing village officials to use the GIS to notify residents of important decisions impacting specific areas within the village boundary. For instance, the engineering department wished to notify residents along a particular street that construction of a road improvement would begin within the next week (Figure 1.26a). It decided to notify all residents along the affected street segment, including residents up to 250 feet beyond the affected segment. The department utilized a buffer analysis and intersection overlay of the buffer with the property map to accomplish its goal. Once the residential addresses of affected residents were identified, they were sent directly to the village's mailing address software for immediate mailing of notices about the construction.

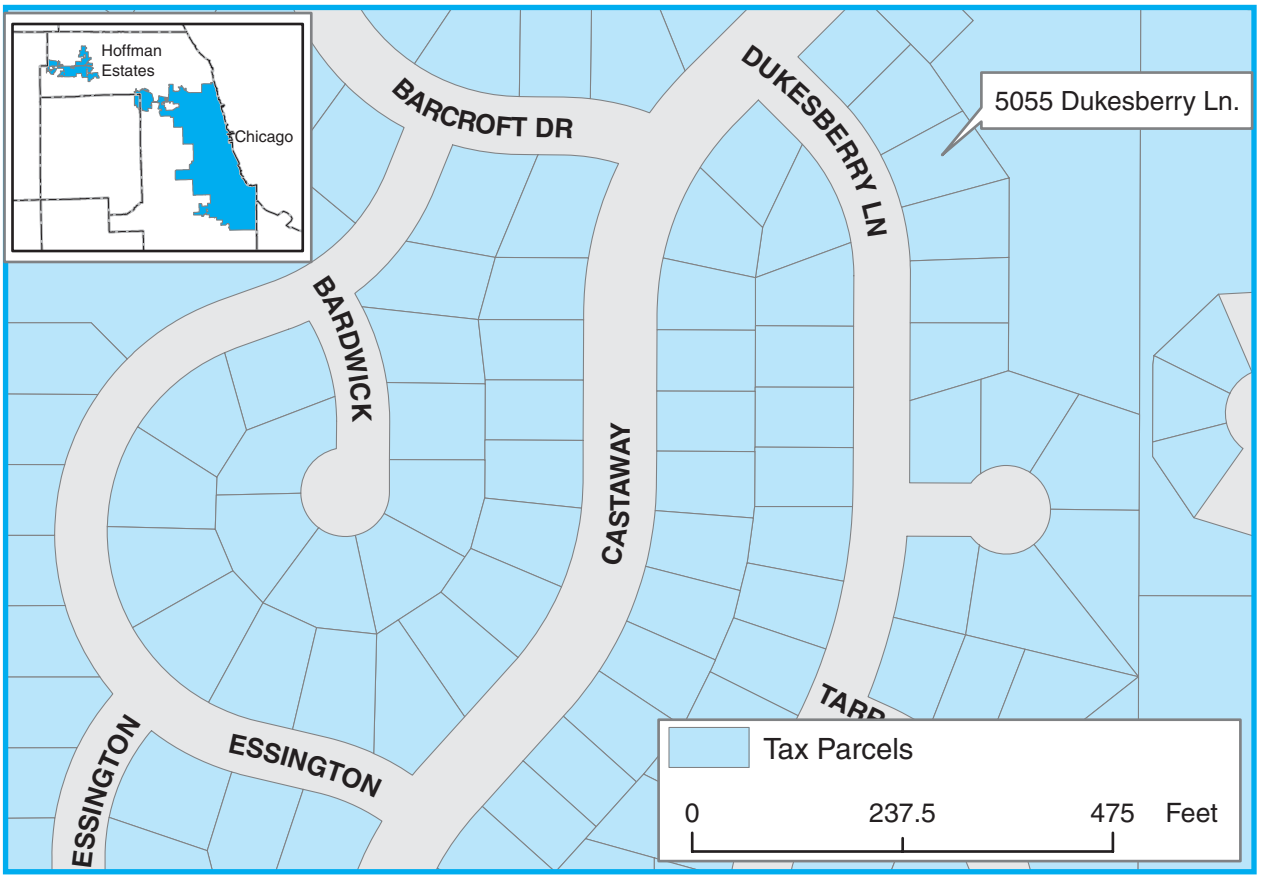
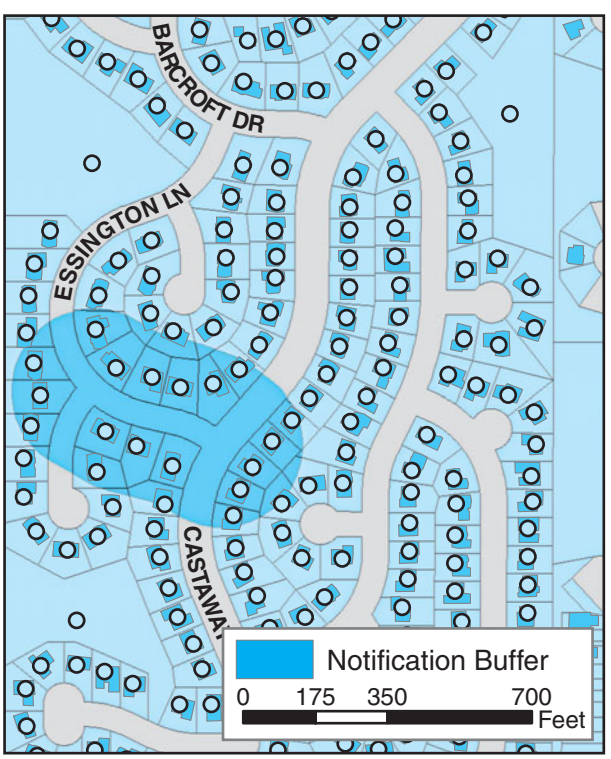
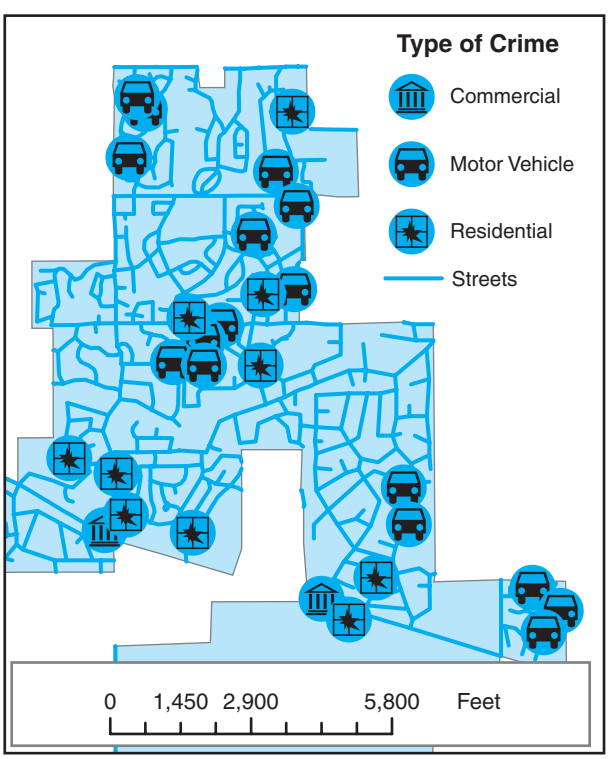


FIGURE 1.25 Hoffman Estates tax parcel GIS.



(a)



(b)

FIGURE 1.26 Hoffman Estates GIS application for address notification and crime analysis. (*Note:* Crime locations are illustrative and not actual ones.)

In the third phase of its GIS development, the village's GIS uses mushroomed. Applications developed for many village functions included crime analysis by the police department, zoning by the planning department, and utility infrastructure by the public works department. By linking a list of addresses representing recent crimes, for example, the police department is able to produce a map with crime symbols (Figure 1.26b), which can assist them in their investigations.

Hoffman Estates was a pioneer in the use of a municipal GIS for the northwest suburbs of Chicago. Many other neighboring municipalities have since adopted GIS for their day-to-day business. As seen in Figure 1.27a, the planning department of the nearby city of Crystal Lake, Illinois, northwest of Hoffman Estates, uses a GIS to maintain an updated zoning map that visually displays multiple special-use permits for each residential property. The six categories on the maps (RE-1, RE-2, etc.) represent all types of residential zoning. For Crystal Lake, the zoning data are maintained in a relational database that is linked to the GIS. Crystal Lake's public works department can register its utility maps and other public works layers to the same GIS base map (see Figure 1.27b, which shows water lines, water valves, and fire hydrants). The layers can be overlaid on top of each other, resulting in a multilayered GIS map that allows the Crystal Lake planners to model complex flow patterns, such as their water distribution system in relation to water demands, population density, and other features in the city.

1.14 AN INTRODUCTION TO GIS AND SPATIAL ANALYSIS PRINCIPLES

This section covers the rudimentary principles of geographic information systems. Its purpose is to enhance your understanding of GIS principles, which will be helpful in performing the lab exercises. If you already have had other coursework or experience in using a GIS, you can skip this section.

Common to most definitions of GIS is the manipulation of geographically referenced information with computer hardware and software. GIS is in use today in geographical analysis and in many other fields, including business marketing, environmental analysis, tax collection, public health, the military, and transportation (Longley, Goodchild, Maguire, & Rhind, 2010).

A GIS consists of boundary files of geographical data, combined with a database of information associated with the *digital map layer*. Map layers are also sometimes called *coverages, boundary files,* or *feature classes*. We refer to them as map layers. Each map layer contains certain geographical features. A GIS might have a single map layer, but more commonly includes two or more layers (Clarke, 2010). For instance, one map layer contains the ZIP code boundaries for the county, a second gives the rivers in a county, and a third gives the point locations of large pollution sources.

As seen in Figure 1.28, the numerical and text data for each map layer are stored in an associated *attribute table* (Clarke,

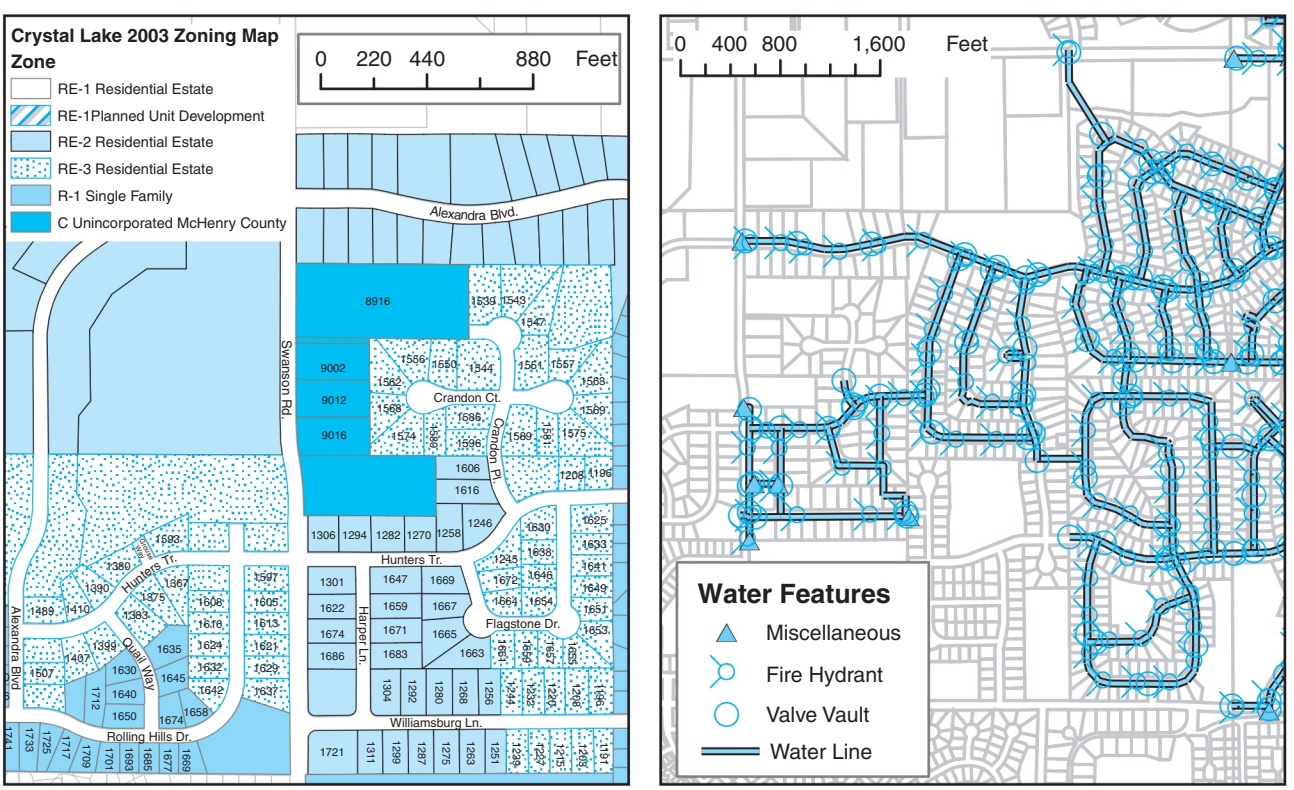


FIGURE 1.27 GIS applications in zoning and utilities, Crystal Lake, Illinois.

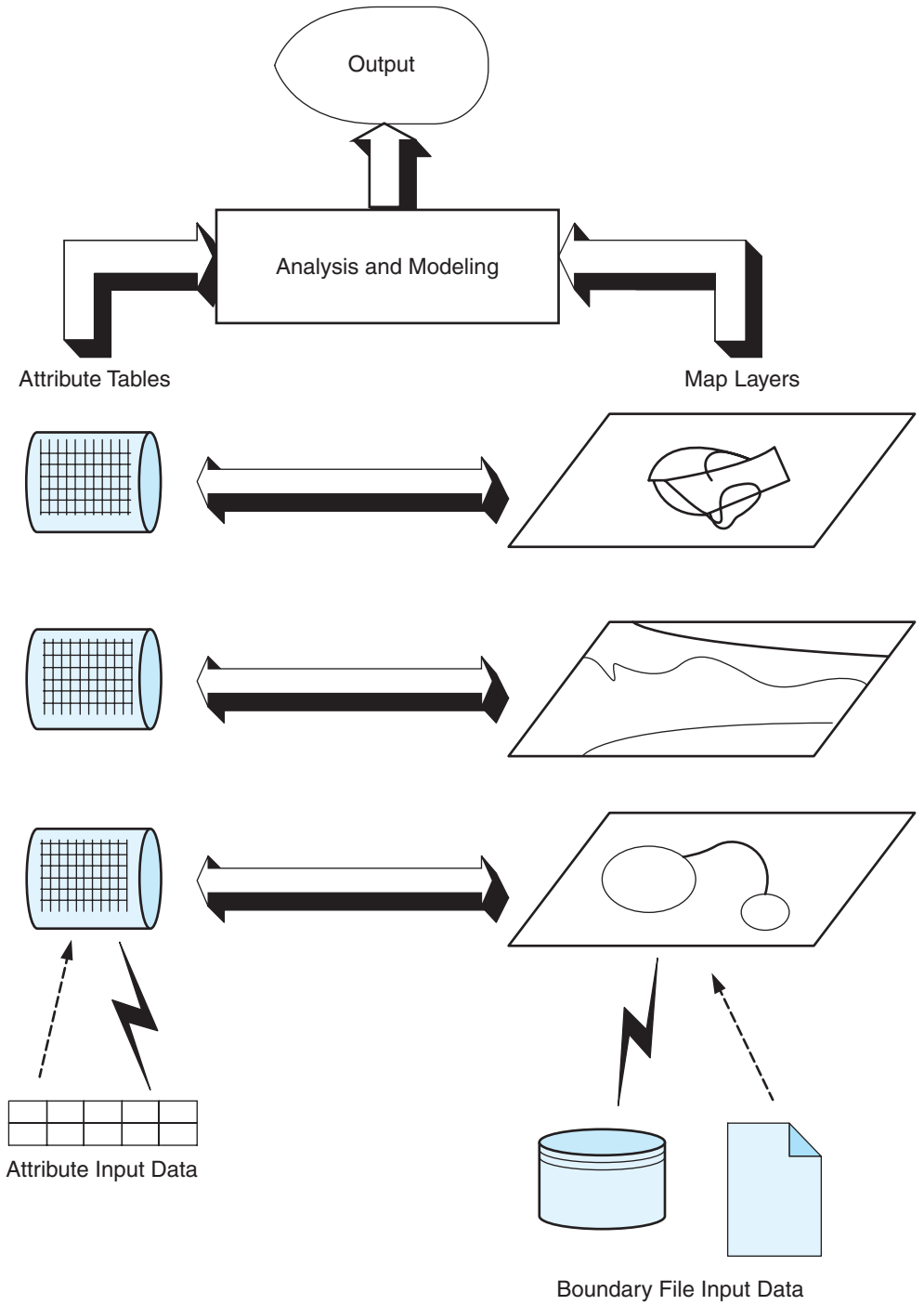


FIGURE 1.28 Design elements of a GIS.

2010). For example, the attribute table on rivers contains the following attributes for each river: geographical coordinates, name, average river flow rate, and average river water temperature. A *geodatabase* is a sophisticated spatial database that combines spatial data with attribute data from all the layers to create a central data repository for spatial data storage and management. The GIS performs analyses and the results are output in a variety of ways, including printed output, screen output, webpages, and displays on mobile devices.

A simple example of GIS use would be to map and analyze the road system in a city. This GIS would have two map layers: one showing the city boundaries and a second showing the highway transportation network. As shown in Figure 1.29, the map layer for the city boundaries has the following attribute data associated with it: population, number of city employees, gross city revenues, and total tax revenues. The map layer for the highway transportation network has the following data associated with each highway: width, speed limit, daily vehicle traffic, and number of gasoline stations.

This application is designed to perform two types of analysis and modeling. First, the density of highway transport can be

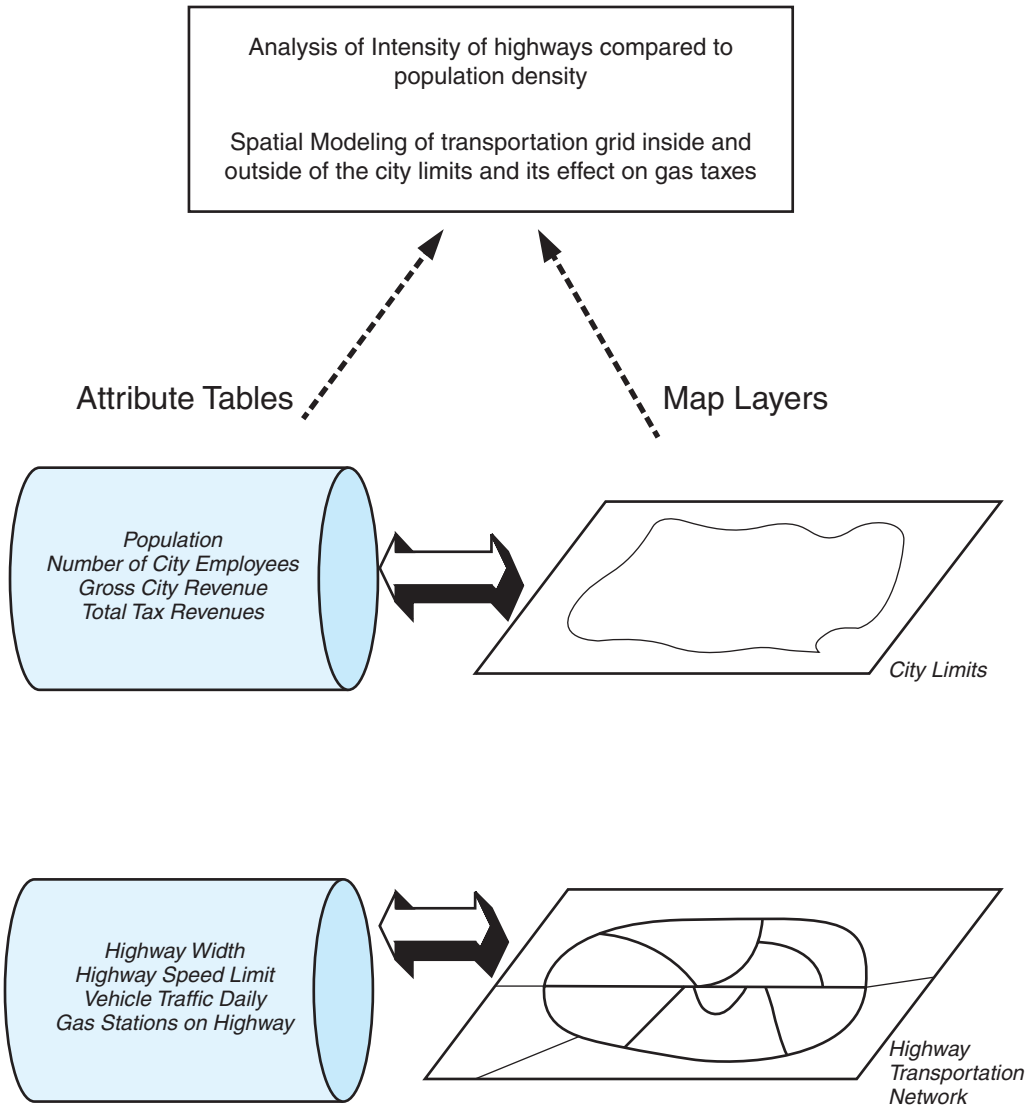

Analysis of Intensity of highways compared to population density
Spatial Modeling of transportation grid inside and outside of the city limits and its effect on gas taxes
Attribute Tables
Map Layers
Population
Number of City Employees
Gross City Revenue
Total Tax Revenues
City Limits
Highway Width
Highway Speed Limit
Vehicle Traffic Daily
Gas Stations on Highway
Highway Transportation Network

FIGURE 1.29 Processing a simple GIS example.

compared to the population density of the city. This allows planners to see how much future need there is for increased highway capacity. Second, the map of the city boundaries can be compared to the map of the highway transportation network to determine exactly how much of the highway grid is located inside and how much is located outside the city limits. This is important because it affects the amount of highway tax revenue that the city receives each year.

The outputs from this simple GIS example include the following:

1. Maps of the city boundaries and the highway transportation network.
2. A combined map of the city boundaries and the highway transportation network, superimposed on top of each other. This is referred to in GIS terminology as an *overlay*. An overlay can have two or more layers superimposed.
3. A comparison of highway density to population density. This is presented in the form of a graph and a table.
4. An analysis of how much of the highway grid is inside versus outside the city limits and a further study of the effect of this distribution on city and state gas taxes. This can be presented in report format as graphs and tables.
5. An analysis of the total length of all highways within the city limits. This GIS analysis might be useful to the city government in estimating total highway maintenance costs.

This example helps in understanding the fundamental capabilities of a GIS, which include the following (Clarke, 2010; Longley et al., 2010):

- Retrieving information based on the spatial location of an item on a map.
- Identifying a spatial location or locations that meet particular criteria. This is sometimes referred to as a query.
- Measuring distances and other spatial relationships. GIS has the tools to make such measurements much easier.

- Analyzing or modeling spatial problems and expressing the results in map or graph form.
- Selecting certain data for map display and displaying the results.
- Identifying selected data either to be transported to another software package outside of the GIS for further processing or to be imported from another software package into the GIS. The ability to transport data into and out of a GIS expands its processing and analysis capability to include many specialized types of computer models and data sources that would not otherwise be available.

As seen from this simple example, to make use of a GIS, you need to have the following components (Clarke, 2010; Longley et al., 2010):

- GIS software;
- Hardware on which to run the GIS software;
- Data, both boundary file inputs in digitized form and attribute input data associated with the boundary files;
- An Internet connection in order to access GIS information and software that are available on the World Wide Web;
- People who understand GIS principles and software and are able to run the applications;
- People with the project management skills to conduct a GIS project successfully from start to finish; and
- Geographers, planners, and other specialists in the study or management of cities who can formulate the relevant questions for a GIS to answer.

1.14.1 GIS Software

For this course, you will be utilizing the GIS software ArcGIS, which is sometimes referenced by its version number—either 10 or the earlier 9.3.1.

1.14.2 GIS Hardware

GIS software packages run on most personal computers, laptops, and netbooks in use today. They run in reduced form on mobile devices such as Apple iPods and iPads, Google Droids, and Blackberries from Research in Motion; most other web-accessible mobile phones.

GIS hardware also includes larger server-based networks and even mainframes. For this course, it is likely you will be running GIS from a desktop, laptop, or netbook computer, which will likely be connectable to the Internet. GIS professionals often have large, high-resolution monitors, sometimes with two screens, because in a GIS you will frequently have many windows open at the same time, and these are easier to see on a larger screen.

1.14.3 Spatial Data

Spatial data are critical to the success of a GIS project. The data can come from a variety of sources, including governments, private companies, web resources such as Geodata.gov and ESRI.com, the USGS, and universities. Gathering the data has often been shown to be the most expensive and time-consuming part of a GIS project (Tomlinson, 2007).

Following are several convenient sources of data.

CENSUS BUREAU, TIGER FILES The U.S. Census Bureau, at http://www.census.gov, provides boundary files corresponding to its geographic units, such as states, counties, cities, and ZIP codes. Along with the boundary files, it has a wealth of attribute information from the U.S. censuses of population, housing, economics, and agriculture, as well as specialized surveys that are georeferenced. Quite a few user-friendly mapping features are available.

The most comprehensive boundary files available from the Census Bureau are called Tiger Files. They give all the geographic boundaries at all levels of census geography from individual city blocks and small streets up to state boundaries and the nation. As a beginner, you are not likely to directly utilize these files.

USGS, DIGITAL ELEVATION MODELS The USGS has been utilizing GIS for many years and has produced particularly good maps showing digital elevations and topography. These maps are available for the entire United States (http://www.usgs.gov). The website includes the USGS Geospatial Data Clearinghouse, which contains large amounts of mapping and remote sensing data for the whole nation, as well as national and international maps, at http://seamless.usgs.gov.

GIS DATA CLEARINGHOUSES These are sources of map layers; attribute data; and satellite, photographic, and remote sensing data. The most prominent data clearinghouses are operated by the federal and state governments, as well as by entities overseas. Examples include the New York State GIS Clearinghouse (http://www.nysgis.state.ny.us), the New Jersey Geographic Information Network (https://njgin.state.nj.us/NJ_NJGINExplorer/index.jsp), and the Georgia State Data Infrastructure (http://www.gis.state.ga.us). Some of the state centers are managed by universities. A user needs to be rather experienced to use the clearinghouses.

GIS DATA DEPOT The GIS Data Depot (http://www.gisdatadepot.com) is a commercial source of extensive GIS data. It includes census data and map layers, Federal Emergency Management Agency (FEMA) flood data, state-specific geospatial data, and much more. This site is for proficient GIS users. Some data are free and others involve a fee.

ESRI, INC. ESRI, Inc.'s website (www.esri.com) contains a large library of geospatial data, much of it free. Its data sets are fully compatible with the ArcGIS software. This site is user-friendly and suitable for beginning and intermediate users.

GEODATA.GOV This is the federal government's one-stop portal for national, state, and local spatial information (http://www.geodata.gov). It includes mapping services related to all aspects of the government, such as environment, agriculture, politics, culture, demographics, education, health, oceans and estuaries, utilities, and transportation. It includes an information center on standards and tools, as well as simple mapping capabilities. There is a very large and growing library of spatial

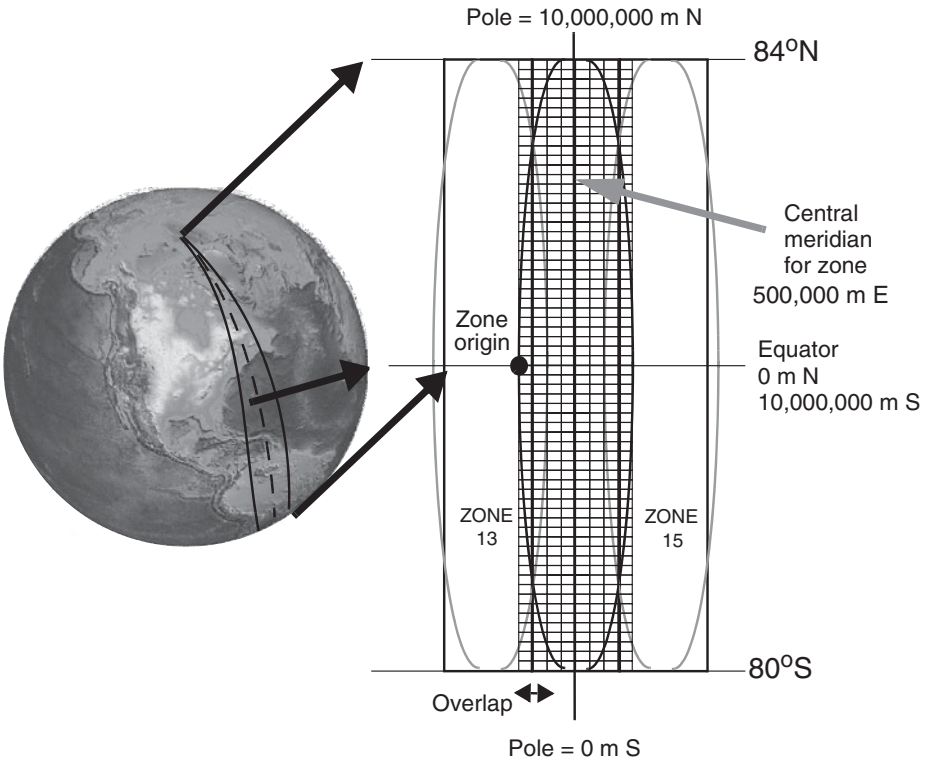


FIGURE 1.30 The Universal Transverse Mercator (UTM) Coordinate System. *Source*: Clarke, Keith C. GETTING STARTED WITH GIS, 4th, © 2003. Printed and Electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, New Jersey. Figure 2.14. P. 50. "The universal transverse Mercator coordinate system."

data and map boundary files. Users can publish and share data and maps with others in a GIS community of their choosing.

ARCGIS.COM Browse ArcGIS online content such as maps and applications published by ESRI and its user community. It is located at www.arcgis.com. Many of the maps are freely available and you can access them directly from ArcMap. Easy to access, and many free data can be loaded into ArcGIS.

1.14.4 Geographical Background for GIS

This section gives a brief introduction to some of the most important geographical concepts for GIS, many of which you will be using in the book's exercises. More complete introductions are available in GIS textbooks (Clarke, 2010; Lo & Yeung, 2006; Longley et al., 2010).

IMPORTANCE OF PROJECTIONS AND COORDINATE SYSTEMS

The most important component in the GIS definition is *geographically referenced information* (Clarke, 2010; Longley et al., 2010). This means that the information is tied to a geographic coordinate system whereby each observation in the database can be precisely located on the Earth. Locations are represented in GIS with the use of x and y coordinates, which represent real-world coordinates (in three dimensions) that have been projected onto a two-dimensional surface. The geographic grid of *latitude and longitude* is a commonly used geographic reference system. It is not a true coordinate system, however, because it measures angles from the center of the Earth in degrees, minutes, and seconds, rather than distances on the Earth's surface. Thus, real-world coordinates are typically projected and transformed into a coordinate system. For instance, many of the map layers used in this book are projected to the *Universal Transverse Mercator (UTM) Coordinate System,* for which the units are in meters (see Figure 1.30). Another coordinate system that is suitable to project to each of the 50 states in the United States is the *State Plane Coordinate System*.

GIS projections transform the three-dimensional (3-D) Earth into a two-dimensional (2-D) flat plane. Some common projections include *Lambert Conformal Conic* and *Albers Equal Area,* with x,y coordinates measured in feet or meters (see Figure 1.31).

Scale is the ratio of the size of the object on the map to the size of the object on the Earth. For example, a scale of 1:100,000 means that an object that is 100,000 feet on the Earth is 1 foot on the map. A map is *small scale* if the fraction (e.g., 1/100,000) is small and *large scale* if the fraction is large. For instance, a map with a fraction of 1/100 is large scale because 1/100 or 0.01 is considered very large compared to most scales' fractions of 1/10,000 or smaller. GIS software often adjusts the scale automatically for the user as he or she is engaged in a session. It also allows the user to adjust the scale of maps as he or she is performing tasks. Often the scale will be adjusted many times during a user session. A tool that automatically adjusts the scale is called a *zoom feature,* meaning that you can zoom in to make things appear larger in size or zoom out to make them appear smaller.

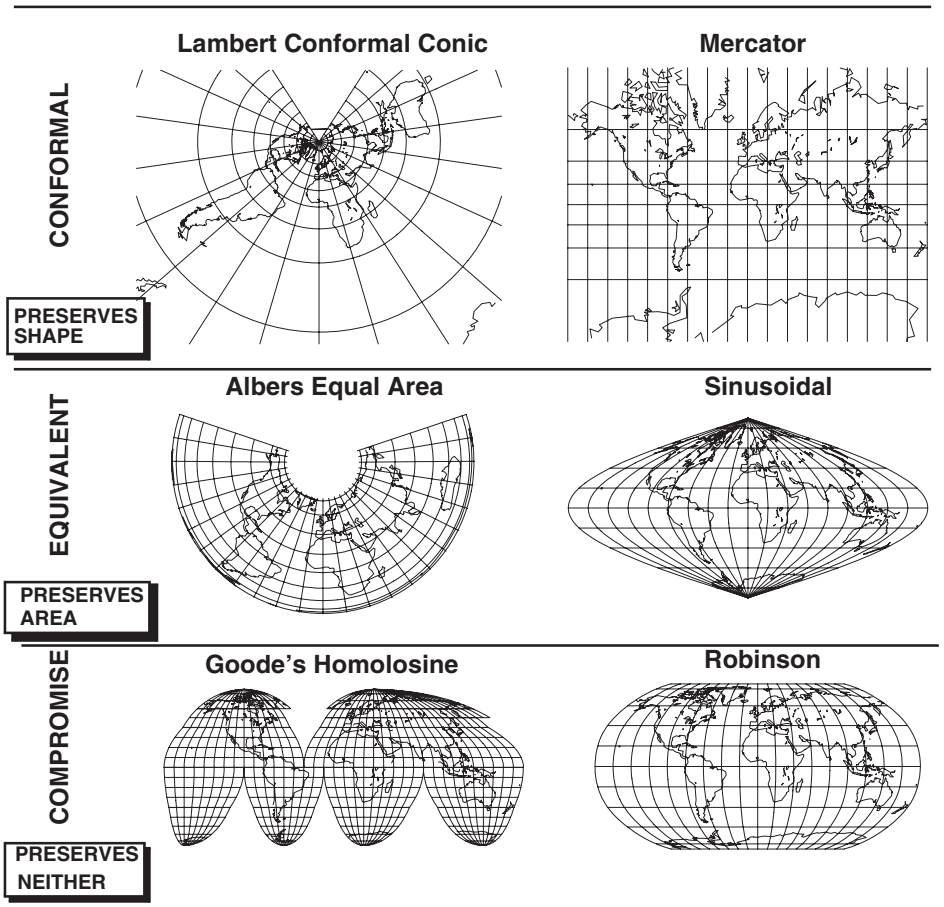


FIGURE 1.31 Examples of projections classified by their distortions. *Source*: Clarke, Keith C. GETTING STARTED WITH GIS, 4th, © 2003. Printed and Electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, New Jersey. Figure 2.10. P. 44. "Examples of projections classified by their distortions."

METHODS OF DATA CAPTURE This course and its exercises are not intended to give you practice with capturing GIS input maps and data. In the exercises, the data and map layers have already been entered in the exercise files on the textbook's website. However, data are a very important aspect of any GIS—and usually the most costly one (Pick, 2008; Tomlinson, 2007). GIS data are commonly entered by inputting digital data available in files on the web or on media such as DVDs. GIS data can also be entered from hardcopy sources by digitizing or scanning. New Earth-based spatial data can be entered by recording points with a GPS-enabled device. Satellites can record geographic data that can be input into GIS layers and converted to recognize points, lines, and polygons.

GPS. Global positioning system (GPS) devices connect to a multisatellite system and can sense the device's position within several meters (Clarke, 2010). For instance, if you take a handheld GPS unit on a hike, you can record your exact Earth surface location at all points of interest (called *waypoints*). When you come back from the hike, you can download all the waypoint locations into your computer. They can be further processed and then entered into a GIS map layer.

GPS units are also built into many other devices today, from cell phones to cars to airplanes to military weapons. This topic is beyond the scope of this text, but good references are available to explain it (Kaplan & Hegarty, 2005).

Digitizing. A digitizing apparatus consists of a digitizing board and a digitizing mouse with a crosshair to pinpoint an exact location. The digitizing tablet is a special electronic surface that senses the exact location of the digitizing mouse. Tablets can be small (i.e., several feet square) or quite large (more than 6 feet on a side). The user moves the mouse from point to point on the digitizing tablet, recording positions from a hard-copy map or photograph. At points of interest, the user clicks the mouse in certain sequences to record point locations.

Scanning. A hard-copy map or photographic surface can be scanned. A crucial aspect of scanning is the need to run vectorizing software on the scanned data, which allows the user to identify the points, lines, and polygons of interest from the scanned document.

REPRESENTING MAP FEATURES IN COMPUTERS Representing spatial data on a Cartesian (x,y) coordinate system is one of the crucial functions of a GIS. Once this is done, the rest is easy because features in a vector GIS are represented as points,

lines, or polygons. Any map can be built up by numerous combinations of these three elements. This approach to representing a GIS is called a *vector GIS* (Clarke, 2010; Longley et al., 2010). A *raster GIS* is an alternative data model that represents features by recording values in a rectangular grid of tiny cells to represent features. Although an important data structure, raster is not reviewed here because the lab exercises in this book rely only on the vector model. Raster applies best to continuous data, such as temperature variations in the atmosphere or shapes of the land surface (see Clarke, 2010). Thus, the exercises do not include continuous features, such as environmental ones.

So how are points, lines, and areas represented in a vector GIS?

- A *point* is recorded as a single *x,y* location. For example, the ten points shown in Figure 1.32 are represented by the coordinate pairs given on the right.
- A *line* or *arc* is recorded as a series of ordered *x,y* coordinates. The nine lines in Figure 1.32 are defined by the coordinate pairs of the ten points.
- An *area* or *polygon* is recorded as a series of *x,y* coordinates defining arcs and/or lines that enclose the area. The nine lines in Figure 1.32 form part of the boundaries of the area shown in Figure 1.32. The other boundaries are arcs. Notice how the first and last coordinates of an area are the same; an area or polygon always closes.

COMMON GIS ANALYTICAL METHODOLOGIES Spatial analysis utilizes the analysis and modeling functions of a GIS (see the upper box in Figure 1.28) (Longley et al., 2010; Mitchell, 1999, 2005). We have already seen several simple examples of the application of various techniques for analysis and modeling. For instance, an overlay exactly superimposes two or more map layers in a GIS to give a combined layer. However, the full set of techniques currently used for GIS analysis and modeling is too numerous to possibly cover in this short introduction. A full treatment is available in specialized sources (Fischer & Getis, 2009; Mitchell, 1999, 2005).

This section, instead, describes only a few important analysis techniques, some of which are utilized in the lab exercises in this book. This small sampling is intended to give you an idea of the range of sophisticated analyses that can be conducted using a GIS.

Buffer Analysis. In buffering, GIS software forms bands on either side of a point, line, or polygon and analysis is performed within the bands. A simple example would be to assign half-mile buffers on both sides of a highway and ask how many service stations are within the buffers.

Map Overlay Functions. As already mentioned, an overlay consists of superimposing two or more map layers.

COMMON ANALYTICAL INQUIRIES IN URBAN GEOGRAPHY ASSISTED BY A GIS

Spatial Analysis. These are techniques that compare spatial features (Lo & Yeung, 2006; Longley et al., 2010). Spatial analysis can, for example, determine how many points are inside a polygon, how many line segments cross a polygon boundary, or how much polygons overlap each other. A practical example would be to ask how many times rivers (lines) cross a toxic waste area (polygon).

Proximity Analysis. Proximity analysis assesses how close certain map objects are to other map objects. For instance, it can determine how close the population residing in a census tract is to grocery stores.

Change Detection. This type of analysis seeks to compare maps over time and assess what significant spatial changes have taken place. This method will become more common, since time sequences of spatial data are becoming more common, and the latest GIS software includes new features for the time dimension. A time sequence for the expansion of the Chicago metropolitan area is the focus of the Chapter 9 exercise.

Modeling and Forecasting. Forecasting and simulation models can be built with spatial data, and the results can be

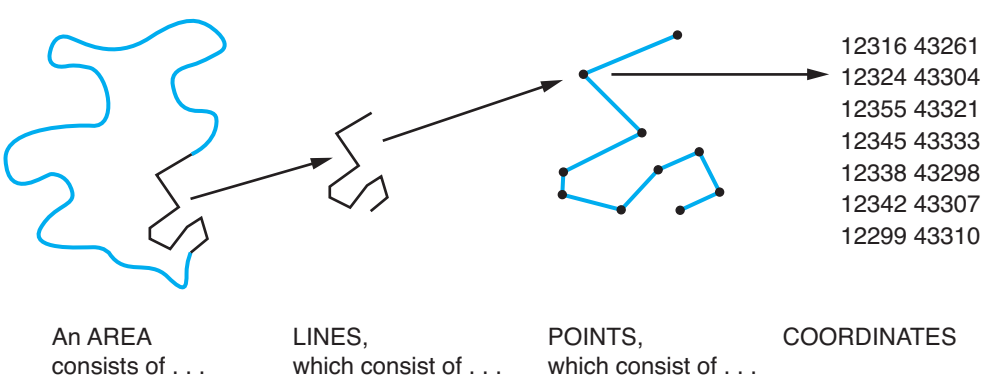


FIGURE 1.32 GIS features represented as points, lines, and polygons. *Source*: Clarke, Keith C. GETTING STARTED WITH GIS, 4th, © 2003. Printed and Electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, New Jersey. Figure 2.19. P. 55. "Geographic information has dimension."

displayed in map form. An example is a model that projects population distribution within a county, based on starting year data. The future population distributions can be mapped to inform planners and the public. Features such as ArcGIS's Model Builder can store a sequence of modeling steps.

Statistical Analysis. Statistical models are often utilized to study the relationships of certain attributes to other attributes (Fischer & Getis, 2009). The techniques used include correlation, regression, analysis of variance, cluster analysis, and *t*-tests. The input data, as well as the results, of many of these models can be represented as spatial displays. This allows enhanced understanding of the geographical effects and influences. Although beyond the scope of this course, a specialized part of statistics, called geostatistics, takes into account spatial effects and interactions, such as spatial autocorrelation.

1.14.5 People and Their Project Management Skills

Essential for any GIS project are trained people who have the skills to complete a GIS project (Pick, 2008; Tomlinson, 2007). GIS training is available through textbooks, software tutorials, university courses, training courses from vendor companies, and web-based training such as ESRI's Virtual Campus. Developing a high level of GIS expertise could take a year or more of training. Besides training, to succeed in a GIS project, people need good project management skills. They need to be able to formulate the GIS problem, decide what steps are needed to solve it, plan out a schedule of tasks, have a way to get feedback from the GIS users, and proceed to accomplish the project on schedule (Pick, 2008; Tomlinson, 2007). Project management becomes even more important for large GIS projects that involve dozens of specialists.

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Suggested Readings

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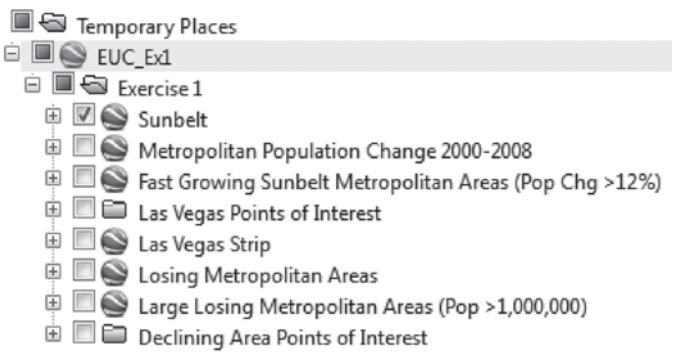
Exercise

Exercise Description
Mapping and interpreting metropolitan growth and decline patterns between 2000 and 2008.

Background Information
In this lab, you examine the process of geographical redistribution of metropolitan population and the Sunbelt concept. The Sunbelt concept is 40 years old, and the exercise allows you to examine what Sunbelt trends were taking place for metropolitan areas between 2000 and 2008.

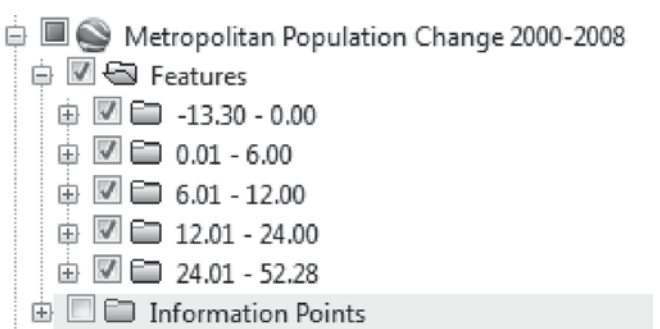
Google Earth Version

1. Launch the Chapter 1 Google Earth KMZ file by double-clicking it:
   EUC_Ex1.kmz
   If you do not see the Table of Contents with layers on the left-hand side, click the Show Sidebar icon at the top to display the Table of Contents.
2. In the Table of Contents on the left-hand side of Google Earth, expand Exercise 1 under EUC_Ex1 under Temporary Places under Places.

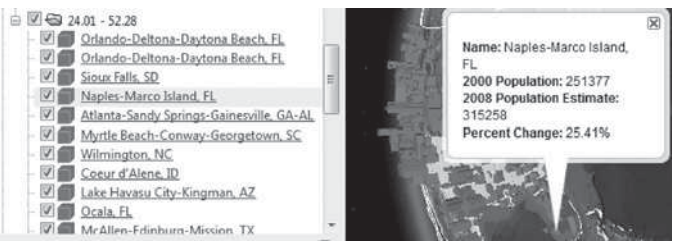


Note: On the zoom bar at the right, you click the + to expand and − to contract.

3. Note that when Google Earth opens, the Sunbelt map layer is turned on. Place a check mark on the second map layer, Metropolitan Population Change 2000–2008. Expand the Metropolitan Population Change map layer by clicking the + next to the layer name and features. You can turn off the information points (letter "i" shown on polygons) by expanding the layer and unchecking the box next to Information Points. This would be a good map to include with your report, so click File, Save, and Save Image to save a jpg image of the map. By clicking to browse the Folders, you can save to the directory you designate.



4. On the map, the fastest-growing metropolitan areas in 2000–2008 are highlighted in red and elevated. For a list of the fastest-growing metropolitan areas, click the + next to the 24.01- 52.28 category of growth. To see a specific fast-growing metropolitan area and its growth statistics, double-click the metropolitan name.



In this example, we see that Naples–Marco Island, Florida, had a 25.41 percent change in population between 2000 and 2008, which was computed by subtracting the 2000 population from the 2008 population, dividing the difference by the 2000 population, and then multiplying by 100:

$$\text{Percent Change 2000 to 2008} =$$

$$[(2008\text{Pop} - 2000\text{Pop})/(2000\text{Pop})]\times 100$$

If you uncheck Metropolitan Population Change and uncheck Sunbelt, you can see the layer of satellite imagery underneath.

5. Now turn off Metropolitan Population Change, and turn on Fast Growing Sunbelt Metropolitan Areas (Pop Chg > 12%). Expand to see specific places included. Click on the area to identify it.

You can see these at different scales by moving the zoom bar at the right. Also, you can grab and move the map by clicking and holding the left mouse button.

Out of the 292 metropolitan areas shown for the 48 conterminous United States, 77 are fast growing (population change > 12%). Of these 77 fast-growing metropolitan areas, 42 are inside the Sunbelt.

Sunbelt Question 1: What percentage of fast-growing metropolitan areas is located inside the Sunbelt?

$$[(42/77)*100] = ?$$

6. Now turn off Fast Growing Sunbelt Metropolitan Areas, and turn on Losing Metropolitan Areas.

   Out of the 292 metropolitan areas shown for the 48 conterminous United States, 49 lost population between 2000 and 2008. Of the 49 declining metropolitan areas, 40 are outside the Sunbelt.

   Sunbelt Question 2: What percentage of declining metropolitan areas is located outside the Sunbelt?

$$[(40/49)*100] = ?$$

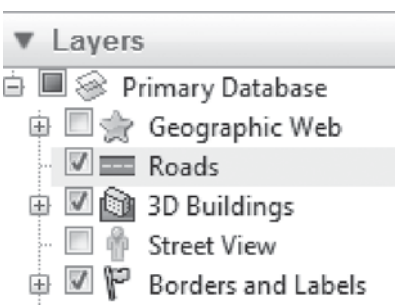
7. Turn off Losing Metropolitan Areas, and turn on Large Losing Metropolitan Areas.

   This map shows 7 metropolitan areas with a 2008 population of 1 million or more that lost population between 2000 and 2008.

   Sunbelt Question 3: What percentage of large declining metropolitan areas is located outside the Sunbelt?

   $$[(6/7)*100] = ?$$

   Six of the seven large losing metropolitan areas were located outside the Sunbelt. New Orleans was the only Sunbelt metropolitan area with a population greater than 1 million to lose population between 2000 and 2008. Why? See Section 1.5 "Hurricane Katrina" in this chapter for a discussion.
8. Now let's go inside a fast-growing area and see what features we can find that demonstrate this growth. Las Vegas was the fastest-growing large metropolitan area and therefore should show landscape signs of growth. Turn off all layers except Las Vegas Strip, and double-click it—this should zoom you to the Strip.
9. To provide more context, place check marks next to Roads and 3D Buildings under Primary Database under Layers in the Table of Contents on the left-hand side of Google Earth.



10. You are zoomed in on the Las Vegas Strip (i.e., Las Vegas Blvd. on the map), which is considered the heart of Las Vegas.
11. Expand "Las Vegas Points of Interest" and double-click Casino Construction, and then use the Google Earth Navigation Compass to tilt the view, looking north toward Flamingo Boulevard. Toggle 3D Buildings on and off to see if you can see any remaining construction of the City Center development. Drag the yellow Street View figure onto Las Vegas Blvd. You can also visualize palm trees and 3D buildings by clicking the button with the building on it.

Las Vegas Strip

Casino Construction

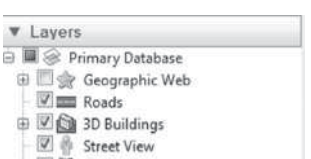
Navigation Compass

12. Next go to the other three Las Vegas points of interest to examine other features of a fast-growing metropolitan area.
13. Next go to Declining Area Points of Interest, turn on Effects of Hurricane Katrina, and double-click it to see an example feature of a metropolitan area that lost population.

The Effects of Hurricane Katrina
Hurricane Katrina struck New Orleans in 2005, resulting in much loss of life and property. Two fixtures of New Orleans post-Katrina were blue roof tarps and FEMA trailers. Aerial photography from Spring 2006 for this location showed a congregation of trailers in the parking lot of an amusement park while many homes in a nearby residential neighborhood sported blue tarps on their roofs. Hurricane Katrina is undoubtedly a cause of the 13% population loss seen in the New Orleans metropolitan area between 2000 and 2008.
Directions: To here - From here
The Effects of Hurricane Katrina
© 2010 Google

To see the exact aerial photo referred to above, click the clock icon in Google Earth, and move the slide timer back to approximately March 31, 2006.

14. Drag the yellow Street View figure onto a street highlighted in blue to see the actual building damage.



You can zoom and move around to observe the rebuilding of sections of the city. By doing selective searches, such as "hurricane damage + New Orleans," you can locate areas of remaining damage and rebuilding.
15. Go to the other three examples of declining metropolitan areas. Google Street View images are also available for some of these locations.

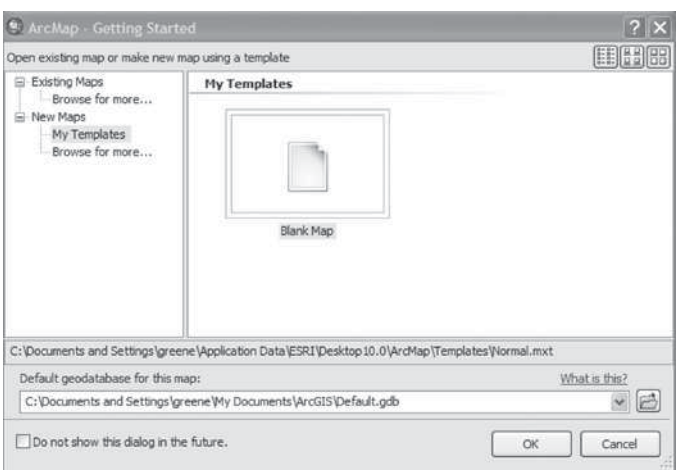
Google Earth Short Essay: Pick two fast-growing metropolitan areas and two declining ones. Zoom in on the metropolitan areas to gain an understanding of the downtown and some other city sec-

tions and of the general layout. What features do you see in the two fast-growing metropolitan areas that reveal their rapid growth? What features of the two declining metropolitan areas reveal their stagnant condition? Include several screenshots to illustrate your points in the essay.

ArcGIS 10 Version

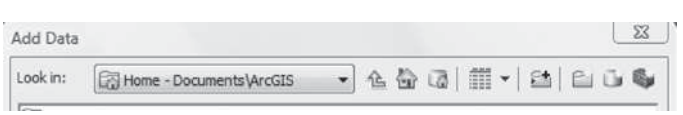
1. Start ArcMap.

2. Under New Maps, click My Templates, and then double-click the Blank Map template in the center to "Start ArcMap with a blank map document."

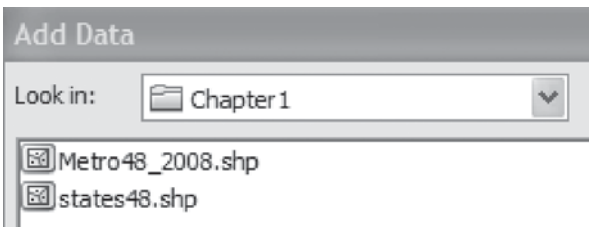


3. Click the Add Data button, and navigate to the exercise data folder.

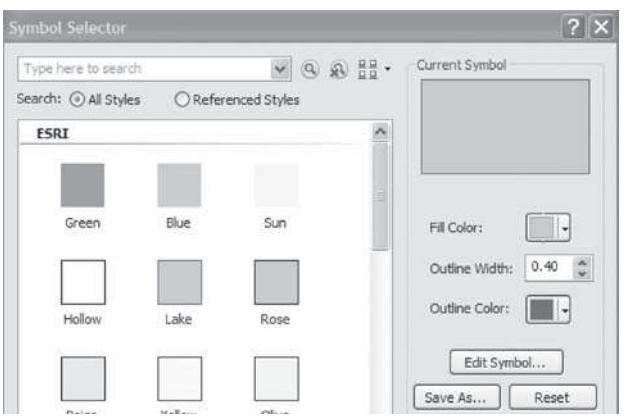
Note: If you do not see the folder where you placed the exercise data, you will need to make a new connection to the root directory that holds the data. The "Connect to Folder" button is the 5th one to the right of the dropdown box on the Add Data dialog box (folder with plus sign). It might be best to connect to the drive letter (i.e., "C:\") where you put the exercise data so that you will see all future datasets regardless of where you put them on your principal drive (i.e., "C:\").



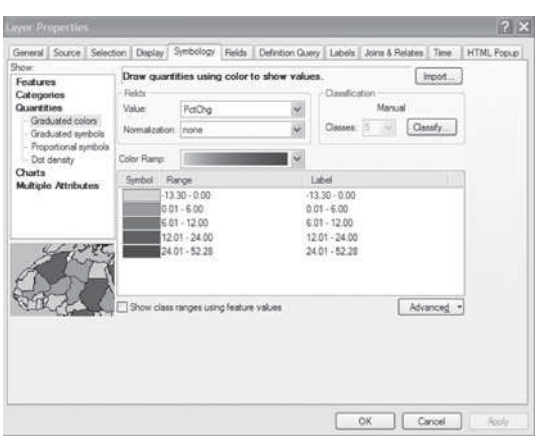
4. Add Metro48_2008.shp and states48.shp from your Chapter 1 exercise folder. You can add both at once by clicking one of the file names and then clicking the other one while holding down the Ctrl key on the keyboard. Click the Add button.



5. The two layers come in selected or highlighted blue, click anywhere in the Table of Contents to unselect them. Ensure that the states48 layer appears first in the list under the Layers data frame. If not, you can click and drag layers to a new position.
6. Click on the colored box below states48 under Layers to start the Symbol Selector.



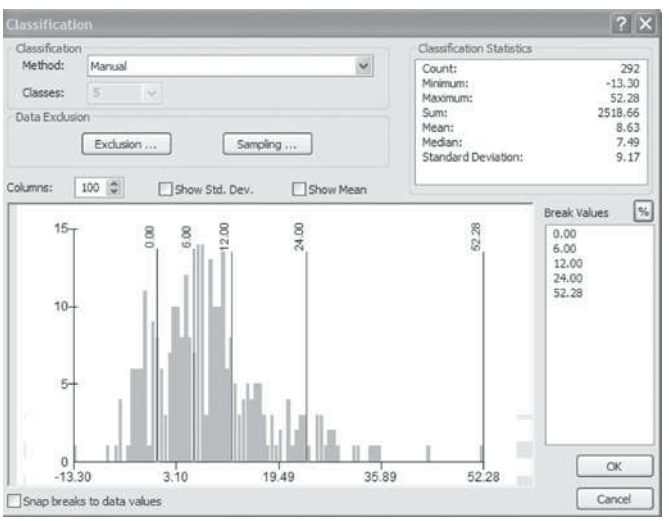
7. Click the Hollow symbol and then OK.
8. Right-click Metro48_2008.
9. Click Properties.
10. Click the Symbology tab.



11. Click Quantities under Show.
12. Pick the light blue to dark blue color ramp.
13. Pick PctChg for Value in the Fields box.

(PctChg represents the percentage of change in the population between 2000 and 2008.)

14. Click the Classify button.
15. Change the break values manually or by sliding the blue bars to the following:
    a. 0
    b. 6
    c. 12
    d. 24
    e. 52.28 (already set correctly)



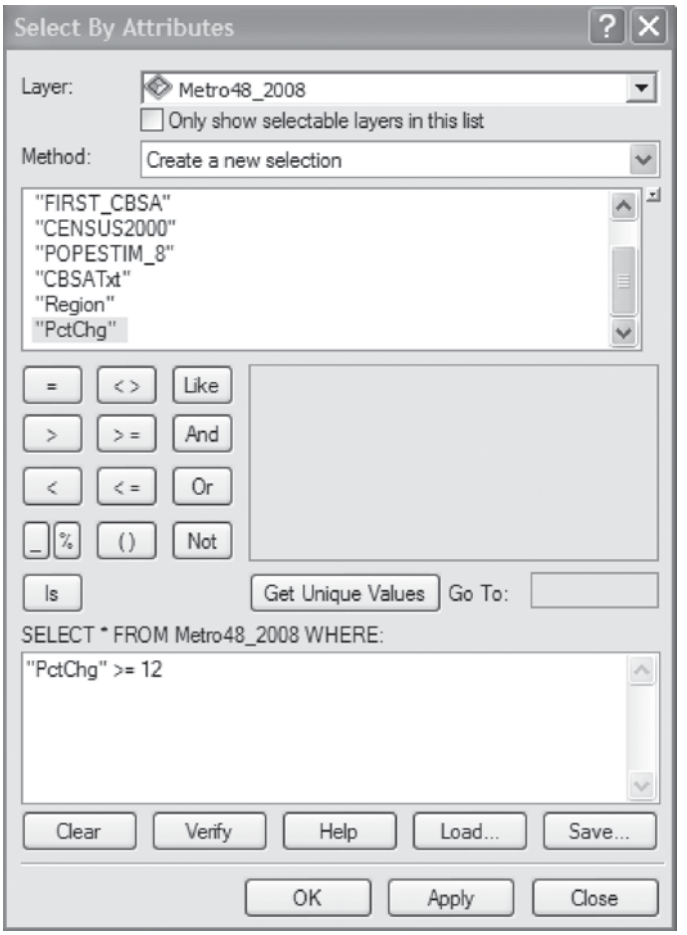
16. Click OK.
17. Click Apply and then OK to see your new classification applied to the Metro48_2008 layer.

The Sunbelt

Considering only the metropolitan areas with a growth rate of 12 percent or higher, calculate the percentage located in the Sunbelt.

18. Click on Selection from the menu bar, and click Select By Attributes. Make sure the Layer dropdown is set to Metro48_2008.
19. Type the following query statement:

"PctChg" >=12



20. Click Apply.
21. Click Close.
22. Right-click Metro48_2008, and click Open Attribute Table; at the bottom of the table, you will see the number of metropolitan areas selected (77 out of 292 Selected).

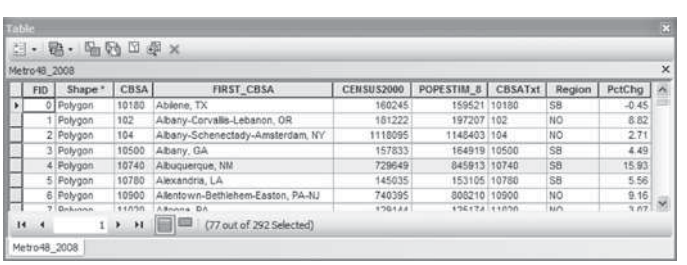


Table
Metro48_2008
FID Shape * CBSA FIRST_CBSA CENSUS2000 POPESTIM_8 CBSATxt Region PctChg
0 Polygon 10180 Abilene, TX 160245 159521 10180 SB -0.45
1 Polygon 102 Albany-Corvallis-Lebanon, OR 181222 197207 102 NO 8.82
2 Polygon 104 Albany-Schenectady-Amsterdam, NY 1118095 1148403 104 NO 2.71
3 Polygon 10500 Albany, GA 157833 164919 10500 SB 4.49
4 Polygon 10740 Albuquerque, NM 729649 845913 10740 SB 15.93
5 Polygon 10780 Alexandria, LA 145035 153105 10780 SB 5.56
6 Polygon 10900 Allentown-Bethlehem-Easton, PA-NJ 740395 808210 10900 NO 9.16
(77 out of 292 Selected)
Metro48_2008

23. Close Table, go back to Selection on the menu bar, and click Select By Attributes.
24. Enter the following logical statement to select only those fast-growing metropolitan areas located in the Sunbelt (*Note:* 'SB' refers to "sunbelt" and 'no' means "not in sunbelt"):

"PctChg" >=12 AND "Region" = 'SB'

25. Click Apply and Close. Next open the attribute table by right-clicking Metro48_2008 and choosing Open Attribute Table. You see the number of metropolitan areas selected (42 out of 292 Selected). You can now compute the percentage of fast-growing metropolitan areas located in the Sunbelt [(42/77)*100]. Use your

pocket calculator or the calculator on your computer under Accessories.

Another question is, are declining metropolitan areas inside or outside the Sunbelt?

26. Considering only the metropolitan areas that lost population, calculate the percentage of them that are located outside the Sunbelt ("Region" = 'NO'). This can be done in two queries.

"PctChg" <0 (selects 49 out of 292)

"PctChg"<0 AND "Region" = 'NO' (selects 40)

Answer: [(40/49)*100]

27. Considering only the metropolitan areas that had a 2008 population of 1 million or more (2008 population is represented by "POPESTIM_8") and that lost population between 2000 and 2008, calculate the percentage of those metropolitan areas that are located outside the Sunbelt. (*Hint:* Keep in mind that the base for your percentage calculation is the number of 1 million-plus metropolitan areas that lost population in the 8-year period, which was 7.)

"POPESTIM_8"> = 1000000 AND "PctChg" <0

"POPESTIM_8"> = 1000000

AND "PctChg" <0 AND "Region" = 'NO'

Answer: [(6/7)*100]

New Orleans was the only Sunbelt metropolitan area over 1 million to lose population between 2000 and 2008. Why?

28. To compose and print a Sunbelt map, first click Selection and then the Clear Selection button.

29. Select Layout View under View to compose the map for printing.

30. Click File and then Page and Print Setup. Change Orientation from Portrait to Landscape, and click OK. Resize the data frame to fit the landscape page by clicking a corner and dragging it to fit the page.

31. Click the Insert Menu to insert a legend. In the first dialog box, make sure that the only legend item is Metro48_2008. You can remove states48 by selecting it in the right column and clicking the arrow to move it over to the left column.

32. Click Next, and erase the word Legend by backspacing it out.

33. Click Next on the next several dialog boxes, and click Finish.

34. Now double-click the selected legend. Click the Items tab; in the right-hand column, double-click metro48_2008; click Properties; click the General button; uncheck "show layer name" and uncheck "show heading"; click Apply and OK. Click OK as you exit back. Reposition the legend to a suitable spot.

35. Click Insert at the top, and insert a title.

36. Click File and Export Map, change the file type to jpg, enter a file name, and click Save. You can include this jpg map with your essay.

37. Click File, click Save to save the map as a map document file (mxd extension), and click Exit ArcMap. You can launch the mxd directly to see and edit your map in the future, but if you want to include your map in a Word document or other application, then you should access the jpg file you exported.

ArcGIS 10 Short Essay: Using the Sunbelt metropolitan map you created and the Sunbelt statistics you computed, write a short essay describing the spatial patterns of growing and declining metropolitan areas relative to the Sunbelt in the period 2000–2008. Your essay should address whether there are distinct geographic patterns to the growth and decline and offer an explanation as to why these patterns exist. Did Sunbelt metropolitan areas grow more or less than non-Sunbelt ones? Your essay should also address whether the concept of the Sunbelt is still as valid today as it was in the period from 1960 to 2000. Refer to the chapter section entitled "Analyzing an Urban Issue: Sunbelt Growth" and other literature that you have found.

Log in to www.mygeoscienceplace.com for ArcGIS Exercise data files, Google Earth™ Exercise kmz files, RSS feeds, flashcards, web links, and self-study quizzes to enhance your study of the spatial display of urban environments.

CHAPTER

2 Defining the Metropolis

This chapter introduces you to the definitions and key concepts in the study of the city. It starts with the definitions of city, urbanized area, and metropolitan area. These concepts distinguish urban and rural, urbanized area and urban cluster, metropolitan and nonmetropolitan, and administrative definitions of city. The terms, for now, should be thought of as follows: The metropolitan area is a population nucleus together with surrounding communities that are closely linked to it economically. The urbanized area is a densely settled area defined by establishing a threshold population density that is reflective of an urban landscape. The city is a legally defined place. Cities emerge and grow through incorporation, addition of unincorporated areas, and annexation. A metropolis or metropolitan area is regional in scope with a dense urban core and a more sparsely populated periphery. The metropolitan area can be more or less integrated socially and economically, but it often has fragmented political and governance issues.

There is a range of sizes of cities. At the giant end are ones of more than 10 million population, which we term *megacities*. An example of such a giant metropolis is Mexico City. Its 20th- and 21st-century growth from city to megacity was fueled by fertility and rural migration to its periphery. It grew over 60 years through expanding growth rings and a diminishing central core. A limiting factor in its growth has been its natural environment.

The study of defining the boundaries, urban entities, and census distinctions for the metropolis is important because it enables students of urban geography to refer to the appropriate concept and then apply it systematically to support other parts of urban geography. For example, in an analysis of urban sustainability disputes across the western United States, it is essential to define at the beginning whether the frame of reference is the West's cities, metropolitan areas, or urbanized areas. Mobility patterns in the metropolis cannot be understood without defining what boundaries movers are crossing—whether they are city, urbanized area, or metropolitan area boundaries. Although this chapter is principally based on U.S. definitions, the concepts defining Tokyo, Mexico City, and Beijing are discussed as examples of the variety worldwide. You should understand that other nations not covered in the textbook will have their own distinctive definitions of the metropolis that need to be understood before you can analyze the country's urban geography. Since some observers view the largest urban agglomerations as encompassing whole regions, the chapter ends by examining mega-region concepts.

This chapter underpins most other chapters in the book, including the ones on migration, neighborhoods, urban core and edge city contrasts, environmental problems, and urban planning. This chapter's concepts will be used as building blocks to a better understanding of the dimensions of cities and urban areas.

2.1 URBAN AND CITY CONCEPTS AND PROCESSES

The focus of urban studies is the city, but the most difficult task facing a student of urban studies is defining the city. Often people loosely use the term in different ways in everyday conversation. How many times have you been visiting a new place and been asked "Where are you from?" The answer to this question at first might seem simple, but depending on how much time you have, the answer can be quite lengthy, especially if you are from a large metropolis. Consider the person from Oak Lawn, Illinois, a suburb of Chicago, who wishes to be brief in responding and replies "Chicago." This answer will be satisfactory to most Americans, as they can easily place the location of Chicago in their mental atlas (see Figure 2.1). On the other hand, to someone knowledgeable of

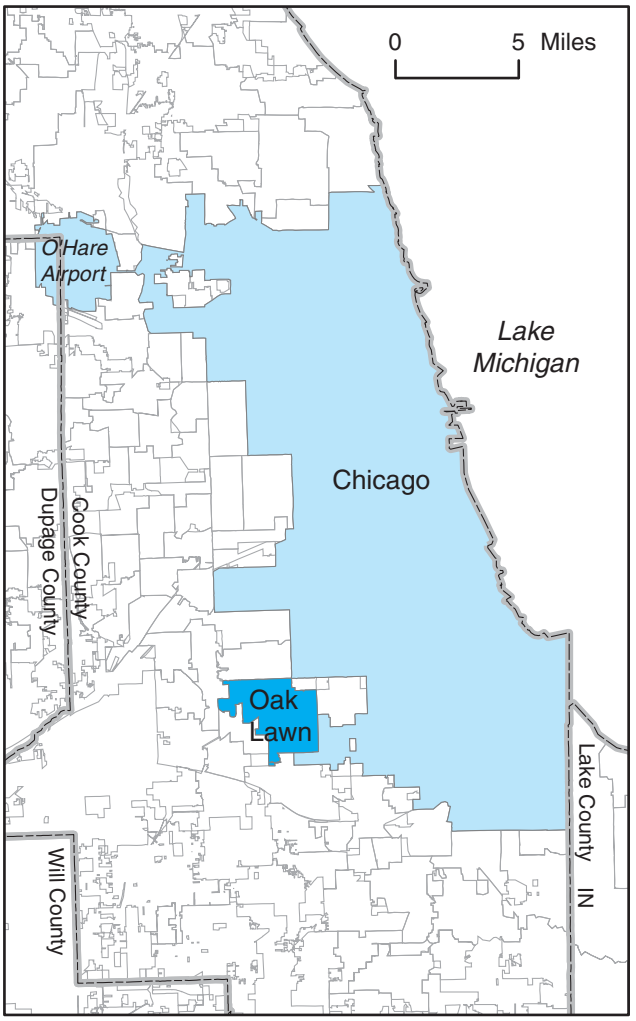


FIGURE 2.1 City concepts: Oak Lawn and Chicago.

the Chicago area, the response might be "Do you mean Chicago proper?" Now the Chicagoan, or so she claimed, has a new challenge: to identify herself as being from Oak Lawn, while holding strong to her original statement. The confusion in this situation arises because there are multiple concepts of the city operating in our day-to-day communication about cities. Yet geographers and government planners are able to define clearly a variety of concepts of city, metropolitan area, and urbanized area.

Defining the city has been a problem for the past two centuries. As early as 1850 in London, the problem of where to draw the boundary between city and countryside existed. This was evidenced by two writers of the time, Thomas Babington Macaulay and Frederick Engels, as cited by Goheen (2000):

> Among the generation of writers who instructed their contemporaries on the modern city even as it was taking shape were Thomas Babington Macaulay and Frederick Engels. . . . When Macaulay sought to instruct his readers on how London circa 1850 differed from what it had been in 1685 this is what he first noted. "The town," he wrote, "did not, as now, fade by imperceptible degrees into the country." Engels found London strange because "a man may wander for hours together without reaching the beginning of the end, without meeting the slightest hint which could lead to the inference that there is open country within reach. . . ." Both were concerned to assess the social significance of the spatial reorganization of a city whose wanton spread beyond its previous limits was erasing all discernable boundaries. (pp. 4–5)

2.1.1 Definitions of City, Urban Area, and Metropolitan Area

A *city* is typically defined as an inhabited settlement of contiguous urban area that is larger than a town or village. In the United States, a city is an incorporated place that is contrasted with a small town or village of fewer than 2,500 persons, which is rural.

Identifying urban places and cities depends on the following factors (Frey & Zimmer, 2001):

- Ecological elements
  a. Size of population
  b. Density of population
  c. Space
- Economic elements
  a. Economic function
  b. Labor supply and demand
  c. Transportation
  d. Economic organization
- Social elements
  a. Social organization
  b. Social character
- Administration

A *metropolitan area*, which consists of a region with a dominant city, is the largest urban concept in terms of area. For instance, Pittsburgh is a metropolitan area that covers a large area of western Pennsylvania, and Miami–Fort Lauderdale–Pompano Beach is a large metropolitan area of southern Florida. A metropolitan area might also dominate a small region. For example, Billings is at the center of a fairly small metropolitan region in western Montana.

Urban places, compared to rural places, and *cities,* compared to villages, are more dense in population; are more crowded in terms of space; have higher-order economies (i.e., not just primary production, but also secondary and tertiary production); have labor supply and demand over broader regions; have more sophisticated economic organization; possess a social character that includes urbanism and city values; and have stronger and more sophisticated administration.

The ecological elements imply a dense agglomeration of population that uses space in a different way than do rural areas. The built infrastructure can accommodate the higher density. Land is divided into more specialized uses.

The economy of a city has more diverse and specialized functions. The urban place engages in little, if any, production of agriculture or raw materials (i.e., primary production), but receives them from outside in exchange for manufacturing and services (i.e., secondary and tertiary production). There is a larger labor market of supply and demand that extends beyond the city to a wider region, national or international. The more advanced economy requires a

larger and more complex transportation network for movement of people and goods. Flows of money and information are also more complex. The size and scope of enterprises tend to be larger in urban places.

Urban places and cities, compared to rural areas and villages, also might have different values, perceptions of the world, and behavior patterns—a different "way of life" (Frey & Zimmer, 2001; Wirth, 1938). Wirth termed it *urbanism as a way of life*. It refers to a more sophisticated, plural, multicultural, and complex way of living and viewing life. The differences are often portrayed in literature or movies, with images of the "farmer" versus the "city slicker."

The administration of cities versus villages is quite different. A *village* is a small settlement of up to 1,000 persons. Often a village or town has small administrative offices, reduced government structure, and limited functions. A *town* is somewhat larger than a village, having up to 2,500 persons. On the other hand, a city has a multifunctional government administration, elected officials, and a city council or the equivalent, with broad government powers to tax, set regulations, control, police, plan, and provide services. In the United States, a village or town sometimes is incorporated, while a city is always incorporated.

The governments of cities, as well as many associated metropolitan agencies, perform significant municipal functions. The services they provide are essential to the daily living of residents, as well as the functioning of businesses and organizations. Among these services are transportation, public health, environmental monitoring and control, consumer affairs, business development, family services, public education, building and housing monitoring and approvals, municipal courts and legal services, information services, public safety, jails, utilities, sanitation, libraries, cultural institutions, parks and recreation, and planning. In the United States, these services are provided through administrative offices that are directed by elected officials and overseen by public representatives. For a large city, the annual budget to provide these services can run into billions of dollars. Municipalities need to generate the revenue to support these functions. All these entities must strike a balance from year to year in the provision of services versus the receipt of revenues through taxes, service charges, revenue sharing, and other sources.

National censuses and statistical agencies have problems measuring all these dimensions, so the main ones used worldwide to officially define urban places are size of population and administration (Frey & Zimmer, 2001). In the United States, urban places are defined as those having a population agglomeration of 2,500 or more. This is the most common way to define urban places, although many nations have different cutoff sizes for an urban agglomeration (e.g., for India, it is generally a population of 5,000 or more).

An *urbanized area* (UA) consists of a central city and its surrounding thickly settled area. On the other hand, a *metropolitan area,* according to the U.S. Census Bureau (2004), is defined as a substantial population nucleus, surrounded by adjacent counties that have significant commuting linkages with the central nucleus. This metropolitan definition implies a more spacious region in which not all land is built up; rather, it has a mixture of open and built-up land on the periphery; the main determining factor in the inclusion of peripheral open land is a certain level of commuting to the central nucleus. Later in the chapter, the concepts of UA and metropolitan area are discussed with respect to the official U.S. definitions.

2.1.2 International Comparisons

Across nations, the definitions of all these concepts—urban, city, UA, and metropolitan area—vary. This becomes a weakness for efforts to study cities worldwide because it is hard to classify them systematically. Even organizations such as the United Nations base their world urban area rankings on urban definitions that do not use consistent geography (see Table 2.1). For instance, the latest United Nations rankings for Tokyo, New York, and Delhi are based on the UA populations of each, whereas Mexico City and São Paulo are ranked on the basis of their metropolitan area populations. Meanwhile, the ranking of Shanghai is based on a city proper (municipal) definition, although for China these areas typically include substantial rural areas (Forstall, Greene, & Pick, 2009).

An advantage of having different definitions is that censuses and statistical agencies in countries collect a large amount of social, demographic, and economic data that are keyed to that particular nation's definitions. However, it becomes difficult to make consistent comparisons among a group of cities if some use metropolitan area and others use municipality or urbanized area. These inconsistencies are being addressed (Forstall et al., 2009; Champion & Hugo, 2004). The geographic information system (GIS) can be utilized to help modernize and systematize definitions (Forstall et al., 2009; Champion & Hugo, 2004). For instance, the concept of urban area could be systematized to include the central city and surrounding administrative units that are contiguous—that is, those that have common boundaries and significant commuters that work in the central city, a concept termed *consistently defined metropolitan area* (CDMA) (Forstall

TABLE 2.1 United Nations 2010 Population Estimates for 10 Urban Areas, by Type of Geographic Area (Population in Millions)

Urban Area	Urbanized Area	Metropolitan Area	Province-Level Municipality (China)
Tokyo		36.1	
São Paulo		19.6	
Mexico City		19.5	
Dhaka		14.8	
Mumbai (Bombay)	20.1		
New York	19.4		
Delhi–New Delhi	17.0		
Kolkata	15.6		
Los Angeles	12.8		
Shanghai			15.6
Beijing			11.7

Source: United Nations. (2008). *World Urbanization Prospects: The 2007 Revision*. New York: Author.

TABLE 2.2 Consistently Defined Metropolitan Areas (CDMAs) Compared to United Nations Urban Agglomerations, 2003. Populations are in Thousands, Estimated for July 1, 2003. Ranks Below 8 Are Not Shown.

	Consistently Defined Metropolitan Area			UN Urban Agglomeration		
	Rank	Population	Average Annual % Change in Population	Rank	Population	Average Annual % Change in Population
Tokyo	1	32,450	0.66	1	35,000	0.50
New York	2	21,600	0.56	3	18,300	0.72
Seoul	3	20,550	1.12	22	9,700	–0.67
Mexico City	4	20,450	1.54	2	18,700	1.02
Jakarta	5	19,400	0.75	10	12,300	3.60
Mumbai (Bombay)	6	19,200	2.53	5	17,400	2.62
Sao Paulo	7	18,850	1.57	4	17,900	1.39
Delhi–New Delhi	8	18,600	3.86	6	14,100	4.18

Sources: Forstall, R., Greene, R., and Pick, J. (2009). "Which are the largest? Why lists of major world urban areas vary so greatly." *Tijdschrift voor Economische en Sociale Geografie* 100(3):293, Table 5; United Nations. (2004).

et al., 2009). Table 2.2 shows the population in 2003 of the world's eight largest metropolitan areas according to the CDMA definition, compared to the same cities using the United Nations urban agglomeration (United Nations, 2004). Although 6 of the cites are common to the two lists, Seoul and Jakarta are now in the top 8 on the CDMA list, although they are ranked 22nd and 10th on the United Nations list. For such a worldwide consistent definition to be put to practical use, an international organization such as the United Nations or the World Bank would need to adopt it and provide extensive data keyed to the new city unit.

2.1.3 Tokyo

Tokyo is the world's largest urban area, with a 2010 population estimated by the United Nations at 36,094,000 (United Nations, 2008). Tokyo benefited from Japan's urbanization increase in the 1950s and 1960s; the country's percentage of urban population grew from 33 percent in 1950 to 64 percent in 1970. The impetus for this rise was Japan's reconstruction and post–World War II economic boom. The urbanization process has continued, so in 2009 Japan was 86 percent urbanized.

Tokyo is the primate, or dominant, city of Japan. It is located on the southeastern coast of the main island of Honshu. To its west are the large urban agglomerations of Osaka–Kobe, which the United Nations estimates at 11.4 million for 2010, and Nagoya, estimated at 3.3 million (United Nations, 2008). The entire urban complex totals 50.8 million, which constitutes 40 percent of Japan's population. Tokyo's primacy is evident in multiple dimensions, including factory production, universities, government offices, and business headquarters. Its federal government control is reinforced by a requirement that all of the country's 47 prefectures (districts) locate a second office in Tokyo (Williams & Chan, 2008).

The implications of various urban definitions, including population rank, population density, and growth rate, are illustrated for Tokyo in the census year of 2000 (see Table 2.3). For Tokyo, the table shows the city proper and the administrative area called Tokyo Metropolitan Government (Tokyo-to), which is larger than the city, but includes only a small portion of Tokyo's suburbs (see Figure 2.2). The city's mean population density is quite high, at more than 13,000 per km^2 or about 34,000.

The Tokyo UA is given both with an exact definition (based on its densely inhabited districts, or DIDs) and with that definition adjusted to administrative boundaries. The exact definition has a density of over 9,000 per km^2. Adjusting to administrative boundaries adds less than 10 percent to the exact

TABLE 2.3 Population, Area, Growth, and Density for Tokyo by Different Definitions

Urban Definition for Tokyo	Population 2000	Area (km^2) 2000 Census	Population per km^2 2000	Annual Percentage Change 1990–2000
City proper	8,134,688	621	13,099	0.41
Administrative area	12,064,101	2,187	5,516	0.49
Urbanized area	28,271,210	3,084	9,167	0.61
UA (administrative boundaries)	30,402,132	6,657	4,567	0.55
Metropolitan area (MA) (1)	34,493,466	13,504	2,554	0.56
Metropolitan area (MA) (2)	30,724,311	7,628	4,028	0.56

Source: Forstall, R., Greene, R., and Pick, J. (2009). "Which are the largest? Why published populations for major world urban areas vary so greatly." *Tijdschrift voor Economische en Sociale Geografie*, 100(3): 285, Table 3.

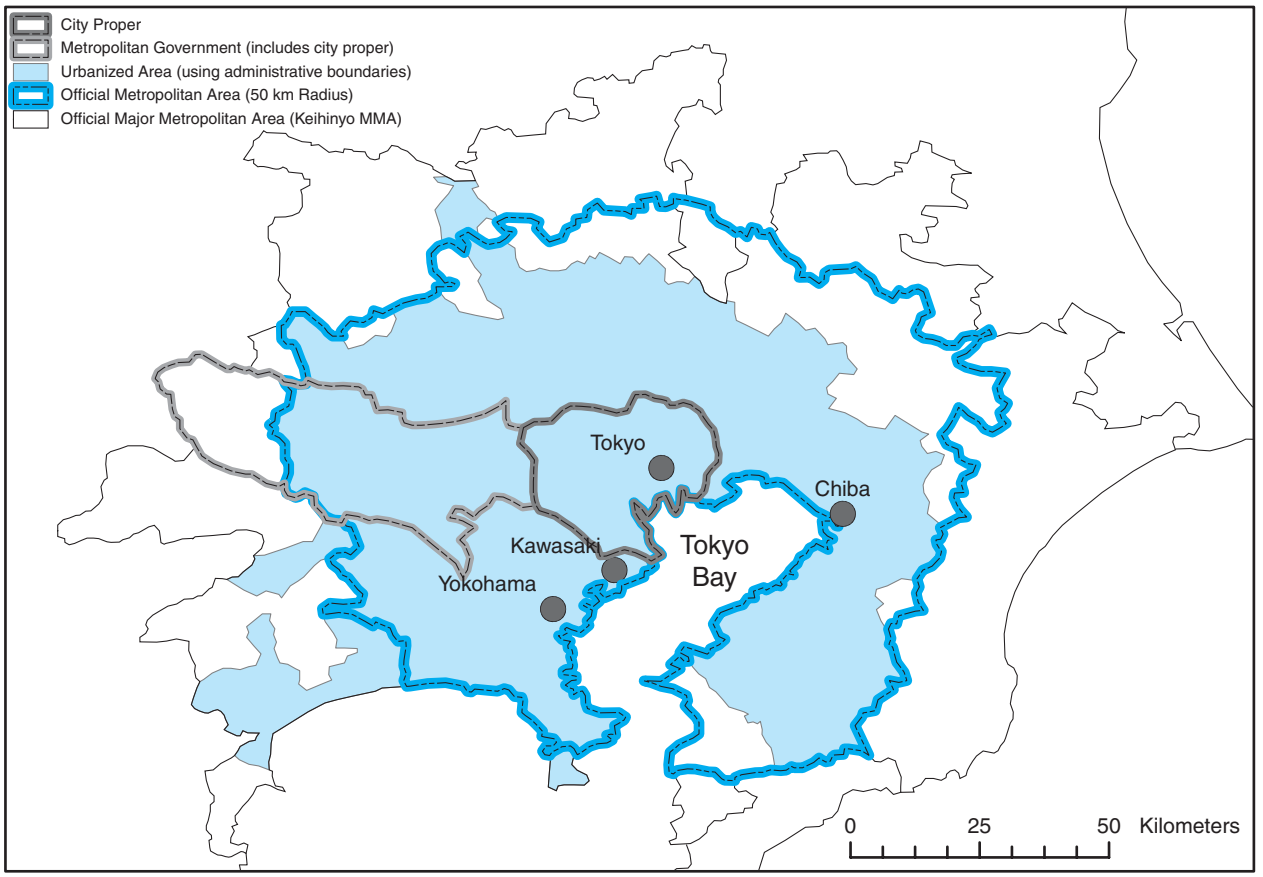


FIGURE 2.2 Administrative area, urbanized area (UA), and metropolitan area definitions for Tokyo. *Source:* Forstall, R., Greene, R., and Pick, J. (2009). "Which are the largest? Why lists of major world urban areas vary so greatly." *Tijdschrift voor Economische en Sociale Geografie* 100(3):277–297.

UA's population, but more than doubles the area included and halves the density (see Figure 2.2).

Two official Tokyo metropolitan areas are shown in Table 2.3. The first is the major metropolitan area MA(1), defined very generously to include all communities that have at least 1.5 percent of their population commuting either to work or to school in the MMA's four central cities (Tokyo, Yokohama, and two less familiar places, Kawasaki and Chiba) (Figure 2.2). The second official metropolitan area MA(2) is defined as the administrative units within 50 km of central Tokyo. It has a somewhat smaller population and a much smaller area than the MMA.

Tokyo's population is growing slowly at about half a percent yearly, according to all of the definitions. The more inclusive definitions all have rather similar rates. The rate for the UA reflects that it expanded geographically during the last intercensal period; for all the other definitions, the growth rates use constant geography.

With this understanding of how this massive urban area is defined, several aspects of its growth pattern and planning can be better understood. For instance, the high population density of the urban area that surrounds Tokyo Bay, as well as the high real estate prices along the bay, have forced developers to reclaim land from the bay, somewhat shrinking its size and disrupting its ecology. Similar pressures have led to the reclaiming of land and the shrinkage of Hong Kong Harbor.

Generally since World War II, metropolitan-wide planning for Tokyo has been weak. Tokyo has grown in a sporadic and haphazard manner. Following the war, Tokyo's city planners considered introducing Western city planning principles, which are covered in Chapter 11. However, systematic modern planning did not get started, due to the many contingencies of the time and the urgent need to rebuild and restore the economy (Williams & Chan, 2008). Also, since the city has city and metropolitan jurisdictions, there was lack of government coordination. Tokyo's sprawl and deficit in master planning are sometimes compared to the growth history of Los Angeles. Tokyo's features today include middle-class suburbanization not supported by adequate transportation and multiple city centers that correspond to the multiple nuclei model examined in Chapter 3. The city centers include the mostly traditional Chiyoda Ward, which contains the Imperial Palace, Tokyo Station, federal government institutions such as the Diet and Supreme Court, and Akihabara, known as "Electric Town," an electronics retail area. The center of Shibuya Ward is located along transport arteries and known for business, fashion, and nightlife. The city center of Shinjuku Ward, seen in Figure 2.3, contains major commerce and business, the busy Shinjuku train station, and the metropolitan government headquarters. The city's geographic pattern is not keyed to ethnic divisions, since Tokyo and Japan have little ethnic diversity.

FIGURE 2.3 Tokyo.

In summary, giant-sized Tokyo can be understood better by examining it through its urban geographic definitions. This text does not have room to delve into all the international differences in these definitions, but the student is referred to Paddison (2001) and Forstall et al. (2009). A unifying theme of all these definitions is the realization that cities, urbanized areas, and metropolitan areas include the elements of urban places and cities described earlier. There are ecological, economic, social, city administration, and city services aspects. The following sections dig deeper into the U.S. definitions and distinctions of urban and rural, city, UA, and metropolitan area.

2.2 CITY SIZE DISTRIBUTIONS AND CENSUS DEFINITIONS

Most national statistical agencies report their population statistics broken out by urban and rural residents. Agencies consider this an important distinction because there is often an assumed economic development advantage to living in urban areas and many of the reported statistics reinforce this idea. Also, it can help differentiate rural versus urban growth patterns. Prior to 2000, the U.S. Census Bureau included places with a minimum population of 2,500 as part of its urban definition, but it now defines as urban all territory, population, and housing units located within a UA or an urban cluster (UC). It delineates UA and UC boundaries to encompass densely settled territory, which consists of the following:

- Core census block groups or blocks that have a population density of at least 1,000 people per square mile; and
- Surrounding census blocks that have an overall density of at least 500 people per square mile.

A *block* is approximately equivalent to a square block in a city, contains a population of about 300 persons, and is the smallest unit for complete census data collection. A *block group* is a group of blocks with a population of about 1,500; this is the smallest unit for sample data collection (U.S. Census Bureau, 2004).

In addition, under certain conditions, less densely settled territory can be part of a UA or UC. This density-based definition is regarded as an improvement on the earlier definition of all persons living in places with 2,500 or more inhabitants because it is no longer based at all on municipal boundaries. It follows then that *rural* consists of all territory, population, and housing units located outside of UAs and UCs.

Metropolitan areas have a range of sizes because of historical growth patterns. Over time, this leads to differences in population and extent that stem from the area's history of economics, jobs, transport, lifestyle, and amenities. In 2003, the U.S. Census Bureau defined 370 metropolitan areas, all having more than 50,000 persons. The largest metropolis in 2008 was New York City, at 22.2 million persons, whereas the smallest was Carson City, Nevada, at 54,867 people. Boston, seen in Figure 2.4, had a metropolitan population of 7.5 million and ranked fifth in the nation in 2008. The importance of cities is seen in the 82 percent of the U.S. population residing inside

FIGURE 2.4 Boston metro landscape.

these 370 metropolitan areas. In 2000, when there were only 280 metropolitan areas, those areas ranked 1 to 10 accounted for 32 percent of the U.S. population, whereas those ranked 11 to 30 comprised 18 percent. Metro areas ranked from 31 to 280 accounted for 33 percent of the population (see Figure 2.5). The average sizes for the three classes were 8.9 million, 2.5 million, and 1.5 million. Notice that the difference in average size is smaller between the second- and third-ranked groups. The third-ranked group has the most cities—197 of them—with populations between 50,000 and 500,000. As seen in Figure 2.5, in the United States, many Americans are likely to live in one of these smaller metropolitan areas. All this demonstrates that people reside in areas across a range of city sizes. Further, the lifestyle, city environment, and complexity of industry and culture vary along a range from giant cities to small ones.

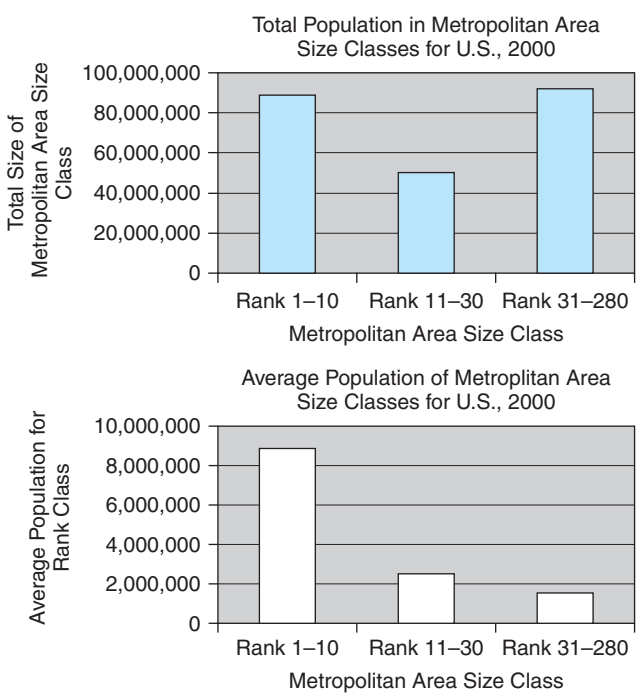


FIGURE 2.5 Varying sizes of metropolitan areas, United States, 2000. *Source*: U.S. Census Bureau, PHC-T-3, 2001.

2.3 CITY AS MUNICIPALITY

The concept of city most frequently used in everyday life is the city as a self-governing unit—for instance, the city headed by a mayor and city council. This is the *incorporated place,* which is a concentration of population with legally defined boundaries and legally constituted government functions. Incorporated places can have a variety of labels, including city, town, village, and borough. The reason a group of citizens and landowners seeks incorporation includes the desire to establish identity, control development, act as a legally recognized body (with the ability to tax and collect revenues), and gain some autonomy from higher levels of government. Some places in the United States have an area identity and have locally recognized boundaries, but are not legally incorporated. They are referred to by the U.S. Census Bureau as *census-designated places*. An example is Mentone, California, which had a population of 7,803 in 2000 and is located in San Bernardino County, on the eastern side of the Los Angeles urban area, 86 miles east of the city of Los Angeles and 21 miles northeast of the city of Riverside. Mentone has an elementary school, a small business area, restaurants, and a below-average income for the region.

Another legal process is *annexation,* which is the inclusion of territory into an existing municipality through expansion of the city limits. The city of Redlands, California, with a population in 2009 of 69,976, is located in an expanding urban region to the east of Los Angeles and adjacent to Mentone. It annexed a significant amount of land between 1990 and 2000 and small land additions between 2000 and 2008 (as seen in Figure 2.6). The motivation for a municipality to annex territory is to

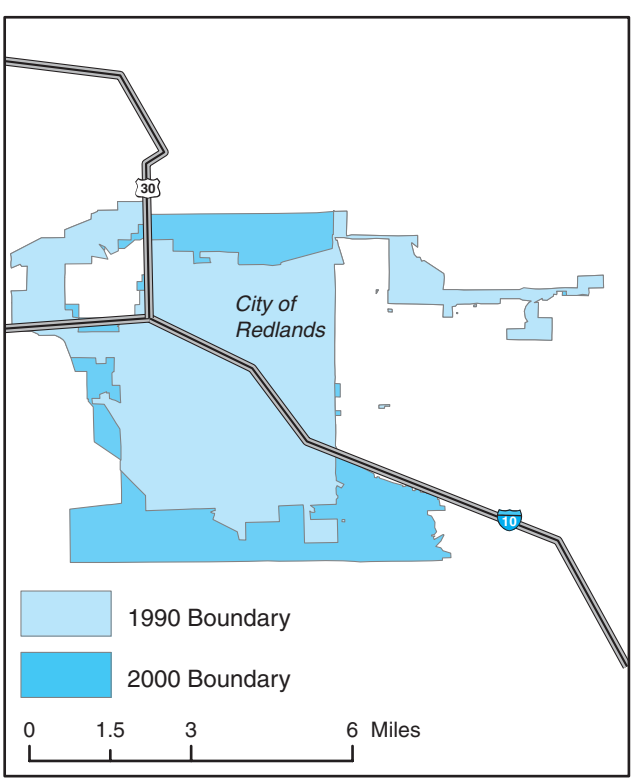


FIGURE 2.6 Annexation in the 1990s for the city of Redlands, California.

regulate development, accommodate population growth, and increase the municipal tax base. A property owner's motivation to be annexed by a municipality is often to gain services such as water and sewer hookups. Also, services such as fire and police protection and street maintenance might be enhanced if an area is annexed by a city. The likelihood of approvals to develop property and a sense of certainty about how and when development might occur are additional reasons some owners might support annexation.

State laws differ with respect to new incorporations, new unincorporated areas, and annexations, and the annexation process differs throughout the United States. Illinois serves as a good example, as it has more municipalities than any other state, with a total of 1,282, compared to a U.S. state average of 385 (U.S. Census Bureau, 1993). *Incorporation* requires a petition by a certain number of electors residing within the area proposed for incorporation. If a majority of voters approve the incorporation, it passes into law. There is no regional or state oversight, although counties can review incorporation petitions within their borders. The result of this process has been the creation of an especially large number of municipalities (i.e., cities, villages, etc.) in Illinois, a good proportion of which are in the Chicago metropolitan area. The many municipalities in this metropolitan area have led to a heterogeneity of city and town development and governance (they are shown in Figure 2.7). Critics of this fragmented municipal geography argue that the structure makes it difficult to achieve consensus on many regional issues (Barnett, 1995).

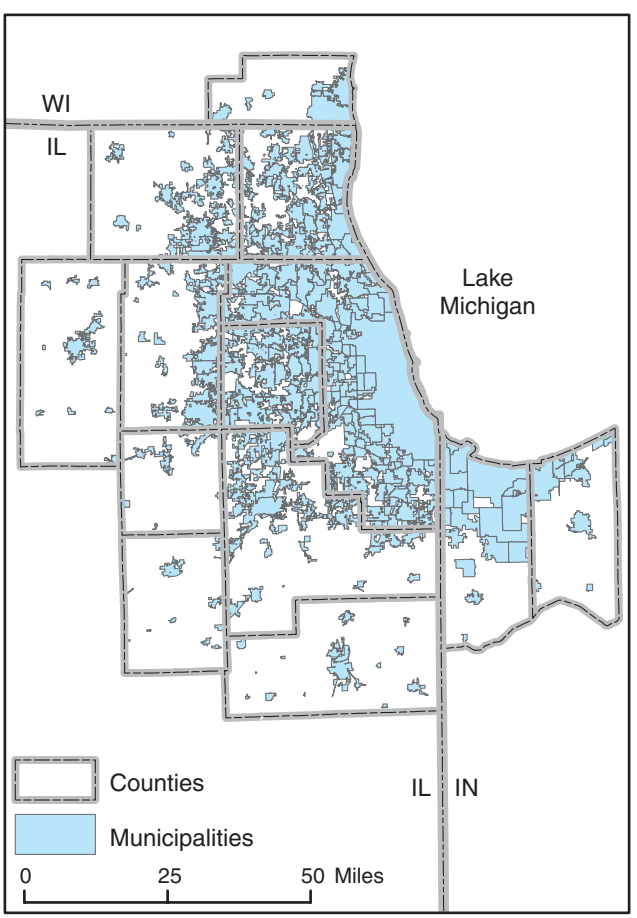


FIGURE 2.7 Municipalities of the Chicago metropolitan area.

Annexation can occur in either of two forms, voluntary or forced. Through voluntary annexation, a property owner or group of owners submits a petition to the municipality requesting to be annexed. Forced annexation can happen when a property is less than 60 acres and is surrounded by one or more municipalities, a forest preserve, and/or state-owned property. In either case, it is necessary for the parcel to be contiguous to the municipality to which it is to be annexed. Some municipalities have stretched the definition of contiguous. For example, it is not uncommon to see municipalities annexing a thin strip of land along a road for some distance to reach and include in the annexation a larger parcel of some economic interest. See, for instance, the city of Redlands, California, in Figure 2.6, which annexed an area just south of U.S. Interstate 10 to obtain water rights. An earlier thin-strip annexation is seen to the northeast.

Florence, Arizona, is an example of the annexation extremes a municipality can employ to increase its municipal tax base and gain money from state revenue sharing that is based on per capita population (see Figure 2.8). Florence has annexed land on its periphery where various prisons were located, allowing it to tap into state and federal funding to pay for such projects as a new town hall and senior center, projects that most towns finance through revenue generated by local property and sales tax (Whiteside, 2002). States can differ on the legal structure of annexation. A key distinction is whether or not a state requires voter consent from the annexed territory (Frug, 2010).

A city must have sources of revenue. Incorporated places like cities are taxing jurisdictions, as well as service providers. In a metropolitan region where there are often multiple incorporated places, the fiscal health of each one is frequently dictated by its geographic extent, its relative location within the region, and whether it has adjacent land to acquire through annexation. Incorporated places that are hemmed in and have no room to expand often find it difficult to balance incoming tax revenue and outgoing payments for services, especially if there is a net movement away among its tax-paying population. In this sense, the landscape of cities that are defined legally almost seems arbitrary in that they take on a variety of shapes and sizes.

Los Angeles is an extreme case, as revealed by the variety in its boundaries in 2000 (see Figure 2.9 on page 50). The city was incorporated in 1850 as a 25-square-mile area that included the Spanish central plaza and encompassed the current downtown. After 1900, it took on a linear shape as it sought to acquire and develop its port to the south in San Pedro Harbor. It took on a large mushroom shape with the annexation of the San Fernando Valley in 1905. This was done for the purpose of increasing the city's assessed tax value to secure bonds to pay for a 250-mile-long aqueduct from Owens Valley in the Sierra Nevada Mountains to Los Angeles (Reisner, 1986).

Ironically, starting in the 1970s, there have been periodic secession movements in the San Fernando Valley to break off from Los Angeles. An attempt at secession was strongly voted down by the Los Angeles city electorate in November 2002. The affluent and mostly White San Fernando Valley

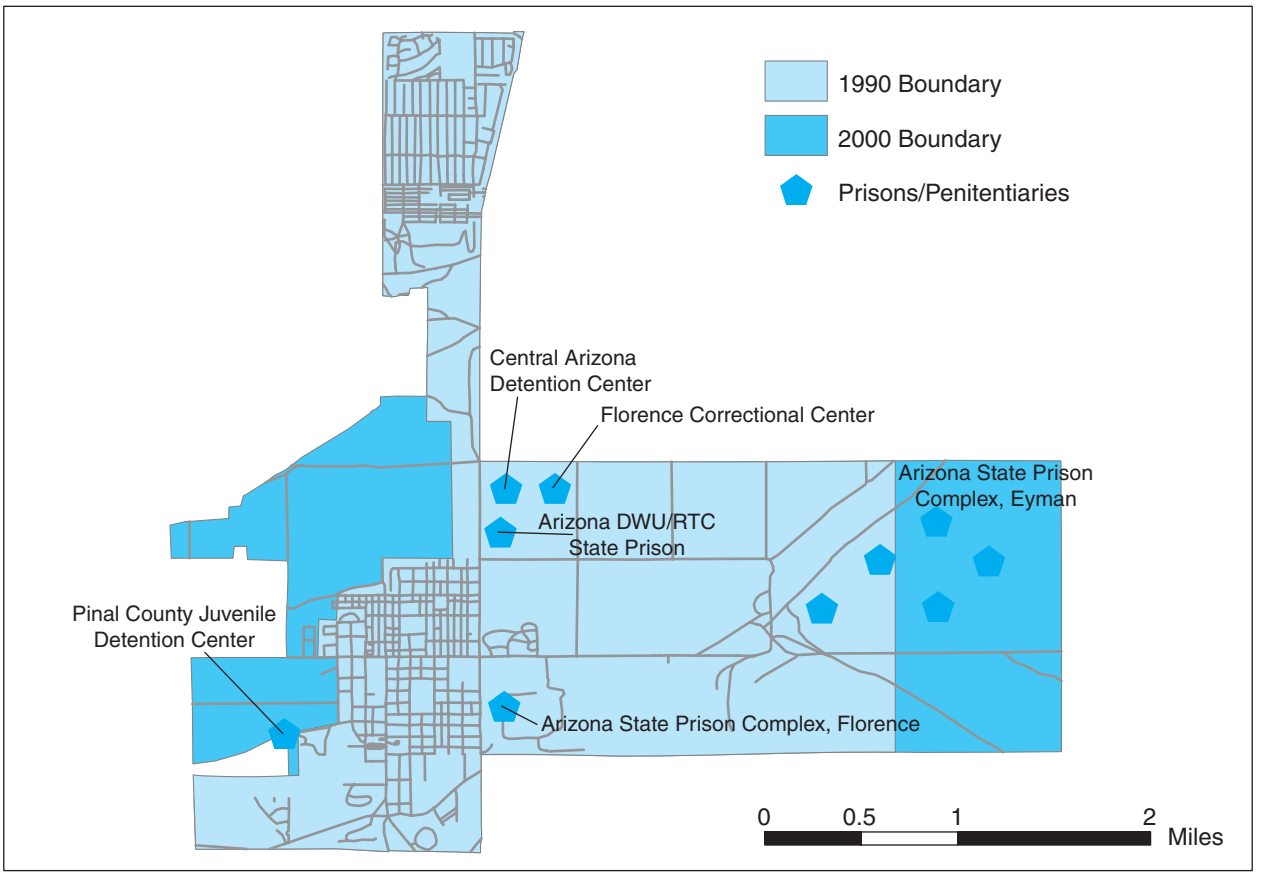


FIGURE 2.8 Annexations in the 1990s by the city of Florence, Arizona. *Source:* Whiteside, R. (2002, February). "Sprawling for prisoners." *Harper's Magazine,* p. 88.

voters and others in favor of the valley's independence from the Los Angeles "bureaucracy" were voted down by the city's multiethnic majority, which found the present city services useful and fairly efficient, including those for the valley (Steingold, 2002).

Another notable characteristic is the number of municipalities that the city of Los Angeles surrounds, such as Beverly Hills, West Hollywood, Santa Monica, and Culver City. These cities have maintained their independence for more than a century, resisting overtures for annexation. Today, Los Angeles has a large and complex shape, with many arms of development.

The annexation history of Chicago's suburban municipality of Naperville demonstrates that the shape, extent, and spatial orientation of a municipality are often a result of competition with neighboring municipalities for available land for expansion (see Figure 2.10 on page 51). Prior to 1964, Naperville was fully contained within DuPage County, but as Naperville annexed land south and westward in the mid-20th century, it eventually encountered the city of Aurora at State Route 59. Naperville then turned south into Will County to acquire more territory. In the late 1980s, 1990s, and 2000s, it crept further southward, consuming a lot of land in Will County. Eventually, Naperville will be limited to the south as it converges with the cities of Joliet and Plainfield, which are annexing northward toward Naperville. This century-long history of growth in Naperville demonstrates the powerful force of annexation in converting and filling in metropolitan areas. Los Angeles and Mexico City also are the result of a long-term process of urban infill to turn what were once scattered towns and cities into a closely knit urban complex, a process that has included some annexation.

2.4 CITY AS A BUILT-UP AREA

The municipal definition of the city is often arbitrary with respect to the placement of boundaries. As a result of the way it grew and annexed land, a city might contain considerable undeveloped land within its boundaries (be overbounded), or it might not be fully inclusive of the developed land of an area (be underbounded). This can be problematic if the municipal definition of city is used to differentiate between a nation's urban and rural populations. Consider the case of the *underbounded city,* which fails to include considerable built-up land within its city limits. Within the United States, the large cities—especially in the Northeast and Midwest—tend to be underbounded, as their historical annexation efforts were of limited success and as neighboring suburbs incorporated and in effect hemmed them in on all sides, preventing additional territorial expansion. Underbounded cities such as Buffalo, St. Louis, Boston, Chicago, and Philadelphia contain less than 50 percent of their metropolitan populations, and their suburban areas have been gaining a larger population share since the end of World War II. The latter trend has been referred to as the "doughnut" city

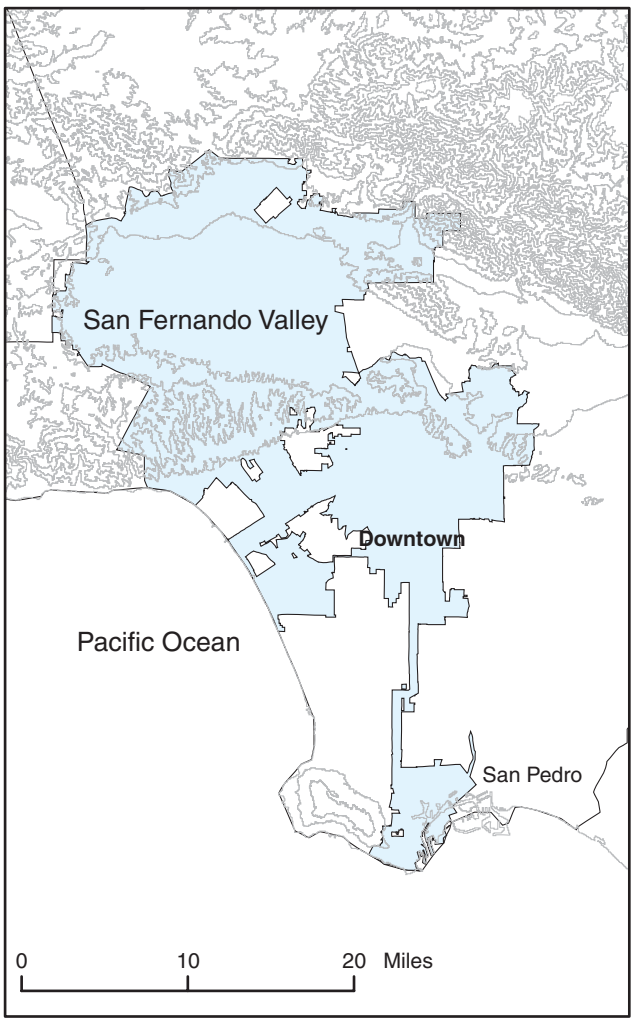


FIGURE 2.9 City boundaries of Los Angeles, with 500-foot elevation contours.

phenomenon, where the loss of population in the inner city conjures up the image of an empty hole in the center. It is evident from St. Louis in the late 20th century that the city limits do not reflect a great part of the region's urban development (see Figure 2.11). Underbounded cities in the West and South include Seattle, Portland, San Francisco, Salt Lake City, Denver, and New Orleans. The underbounded city phenomenon underscores the arbitrariness of municipality shapes and extents.

In Mexico, the same underboundedness occurred for Mexico City, which started to spill over outside its city limits (i.e., those of the Federal District, a federal entity in the city center) into the surrounding State of Mexico starting in the 1960s and 1970s. This has continued to such an extent that today over half of the population of the Mexico City urban area resides outside the Federal District limits (Garza, 2004). This also points to potential governance problems. For instance, the mayor of Mexico City is elected to govern only the Federal District and has little, if any, influence regarding the parts of the urban area in the surrounding state. Thus, to this point, it has been difficult for the mayor to implement public programs that benefit the whole metropolis.

The opposite case of the underbounded city is the *overbounded city,* which contains considerable rural territory and population. The large cities of the southwestern United States are more often overbounded, due in part to liberal annexation laws in the states of the Southwest. Former Mayor of Albuquerque David Rusk (1993) referred to these southwestern cities as "elastic" cities because they can expand to contain their sprawling suburban development, whereas "inelastic" cities like Detroit and Cleveland are far removed from the new development of their regions. The overbounded city often annexes in advance or in anticipation of new development on its edge, thus preventing the incorporations that limited territorial expansion in the older metropolitan areas of the Northeast and Midwest. It is usually easier for the southwestern cities to annex because the surroundings of the city are often thinly settled. As a result, cities such as Albuquerque, San Antonio, and Phoenix contain more than 70 percent of their metropolitan population. There is also a correlation between the fiscal health of cities and the degree to which they are overbounded; that is, underbounded cities have few options in curtailing middle-class flight to adjacent suburbs, whereas overbounded cities can annex in the direction of anticipated "hot spots" and retain the wealthier population.

However, overbounded and underbounded cities have both advantages and disadvantages in their urban settlement patterns. Underbounded cities have the advantage of fewer resources and efforts being poured into planning and annexing at the edges of the urban area. On the other hand, they lose control of development of the edge. Overbounded cities are better able to plan and develop the entire urban area in an integrated way. Their governments have more influence on how the city grows in the broad and strategic sense. The downside is that they might have to sink resources into maintaining undeveloped and even useless land.

The concepts of underbounded and overbounded have major influences on the revenues of and service provision by cities. An underbounded city might not gain adequate revenue sources from its own residents. This is because it might be supporting a workforce larger than its resident population can provide for and it might be responsible for services for a larger region, extending beyond the city limits. This has been recognized in the revenue sharing and grants provided by state and federal governments, but fiscal balance might still not be achieved, as was seen, for instance, in the near bankruptcy of New York City in 1975. On the other hand, an overbounded city can tap into a wide revenue base, including affluent areas located on its periphery. However, because it stretches over larger reaches of territory, it could have problems deploying and managing effective municipal services. It also has more areas of undeveloped land in its outlying reaches that require special types of environmental and natural disaster services, such as fire and flood control. It also faces the challenges of urban planning and development for its outlying territory. Some of these challenges for the two situations can be seen in examples and cases in later chapters.

The complications presented by underbounded and overbounded cities have brought about alternative concepts and definitions to better differentiate urban and rural population. UAs are statistical areas that were first designed by the U.S. Census Bureau in the 1950s to provide a more realistic separation of the urban and rural populations surrounding large cities. In many respects, it was to mimic the exercise of drawing

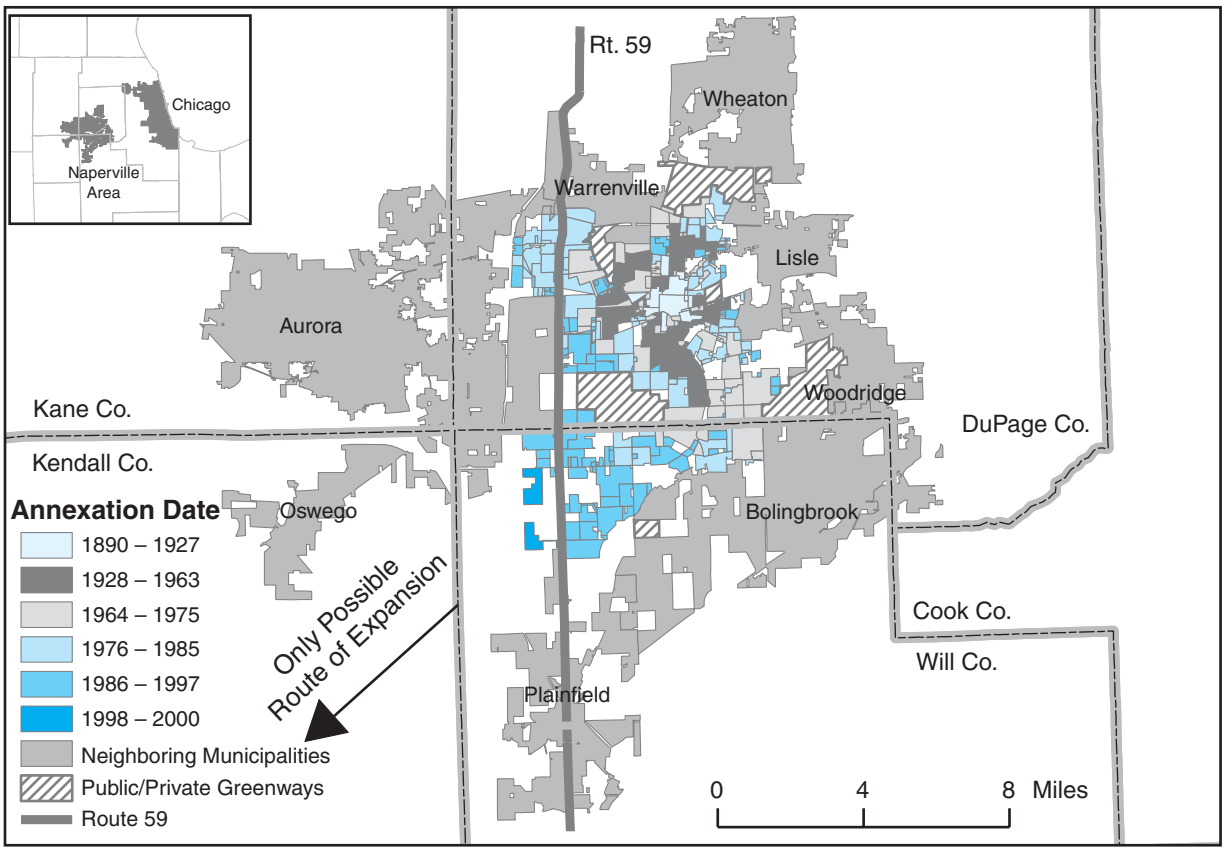


FIGURE 2.10 City of Naperville annexation history, 1890 to 2000.

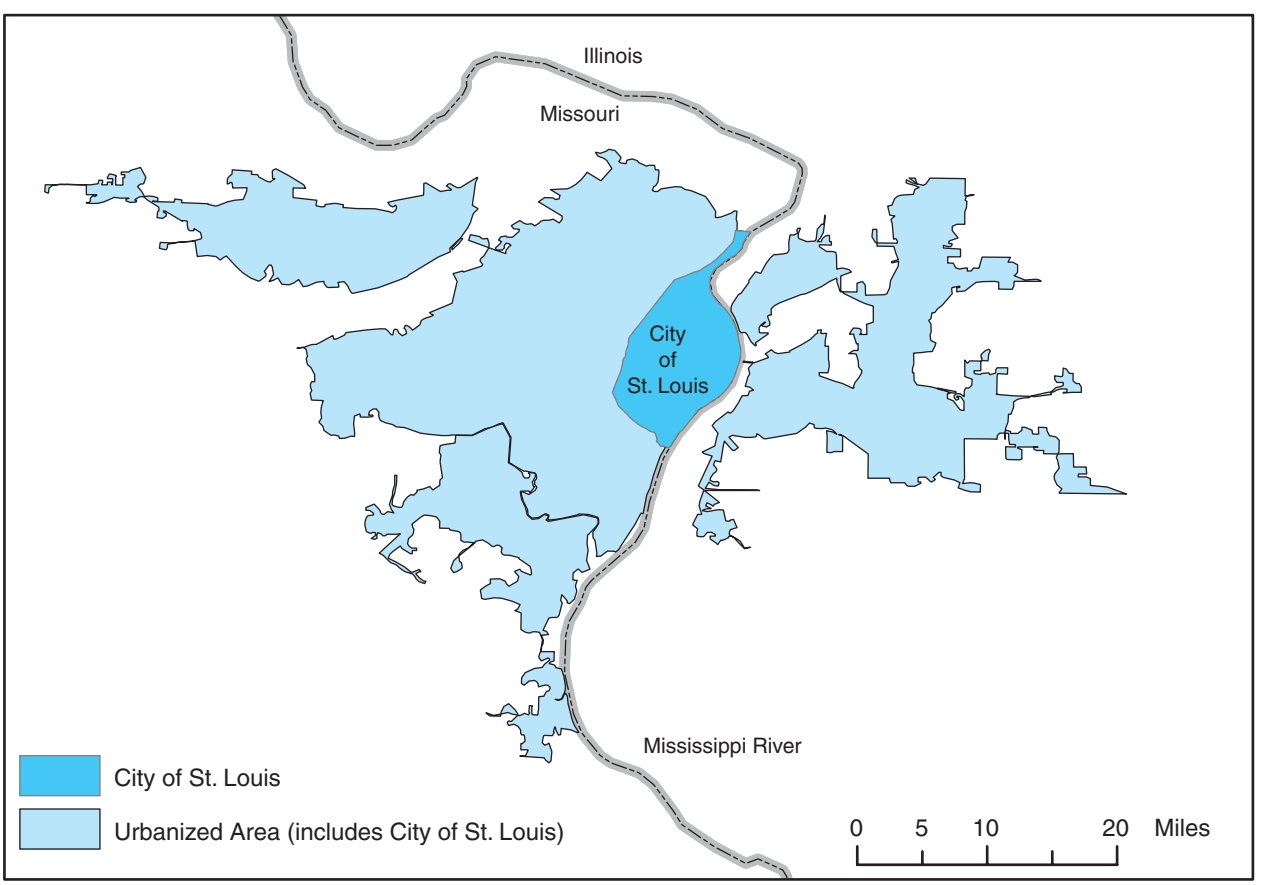


FIGURE 2.11 City of St. Louis relative to built-up area.

FIGURE 2.12 Urban clusters identified on an aerial photograph.

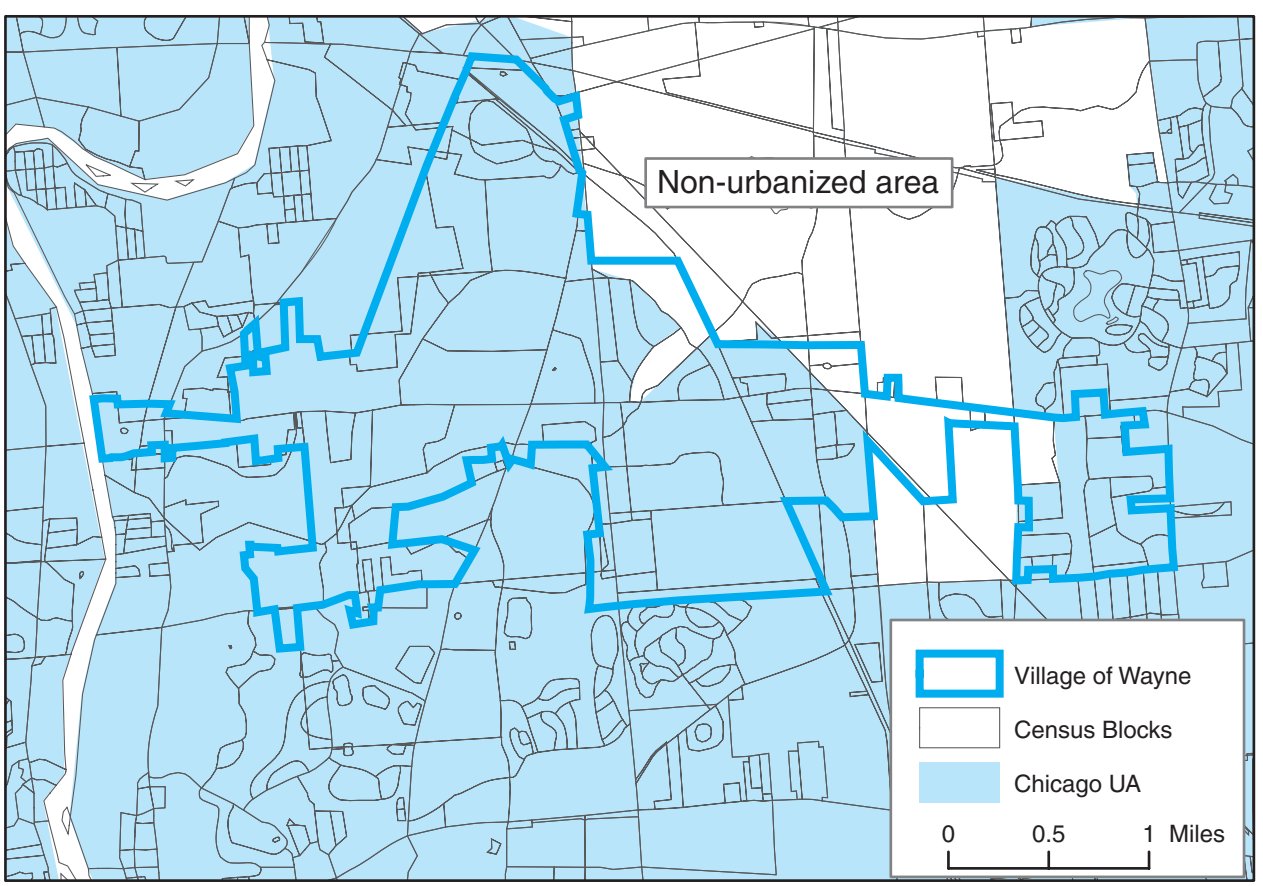


FIGURE 2.13 Wayne, Illinois, municipal boundaries, relative to Chicago urbanized area, 2000.

boundaries around the urban agglomerations you would see on an aerial photograph of a city, while leaving the open spaces between the agglomerations blank. An example of drawing the urban boundaries is seen in Figure 2.12, in which the aerial photograph makes clear how urban and rural areas are interwoven.

A UA consists of a central city and its surrounding thickly settled area. The area boundary is first established by the limits of settlement. Once this area is established, the most important criterion for a UA is that it has a census population of at least 50,000 people. Second, a UA consists of a geographic core area of block groups and blocks with a population density of 1,000 people per square mile and of adjacent block groups and blocks that have at least 500 people per square mile. In cities, a block is often just as it sounds—a city "street block" includes its buildings and residents. However, for the census, it does not always need to be bounded by streets and could have other limits such as a river or a lake. It is important that a UA can cross over and does not need to correspond to the boundaries of incorporated places or census-designated places (see, e.g., Figure 2.13, which shows the Chicago UA crossing back and forth across the place boundary of Wayne, Illinois). The urban cluster (UC), a U.S. Census Bureau concept introduced in 2000, can be thought of as a smaller version of the UA. Like a UA, it is defined in terms of core blocks or block groups surrounded by noncore ones; however, a UC has a total population of only between 2,500 and 49,999 persons.

Figure 2.14 demonstrates the concepts of UA and UC for the Chicago metropolitan area. UAs and UCs are different in that UCs are much smaller in population and they are separated from the urban territory of UAs, as illustrated by the Chicago case. Similar to the historical development of UAs, UCs lie in proximity to major transportation routes. UAs and UCs together are referred to as *urban areas.* Any area that is not classified as an urban area is *rural.*

Another advance in understanding UAs is the availability of aerial photos. These show a more complete picture of the physically built-up portions of cities. It is possible to superimpose UAs defined by the census on digital photos. With the widespread availability of digital orthophoto quads (DOQs) from the U.S. Geological Survey (USGS), a physical approach to UA boundary delineation is becoming more realistic. In the 1990s, the USGS began a state, local, and federal cost-sharing program to produce DOQs nationwide (Robinson, Morrison, Muehrcke, Kimerling, & Guptill, 1995). Although not all counties are available at the current time, most urban counties will eventually sign on, and others could find alternative means for financing their own DOQ production. The only caveat when using a DOQ image for a nationwide program, similar to the delineation of UAs by the census, is that the acquisition date of the photo will vary and will often not correspond to census-taking time. Nonetheless, the use of high-resolution aerial photographs that are georeferenced to other GIS map layers allows regional governments to overcome any perceived shortcomings in the national UA definition by creating their own local definitions. An example of an aerial photo compared to a UA in the city of Aurora, Illinois, is seen in Figure 2.15. Note the portion of Aurora, Illinois, that was included in the 1990 UA, but excluded in the 2000 UA. The area has a low population density, as it is composed of an industrial park, a school, and open land. The local government, on the other hand, would still consider the area to be urban in terms of its built-up character. Nevertheless, the 2000 Census UA definition, although still population based, has improved the correspondence of UA and physically built-up area in many fringe farming areas. The *fringe* is where urban land ends and rural land begins, although no single line separates the two.

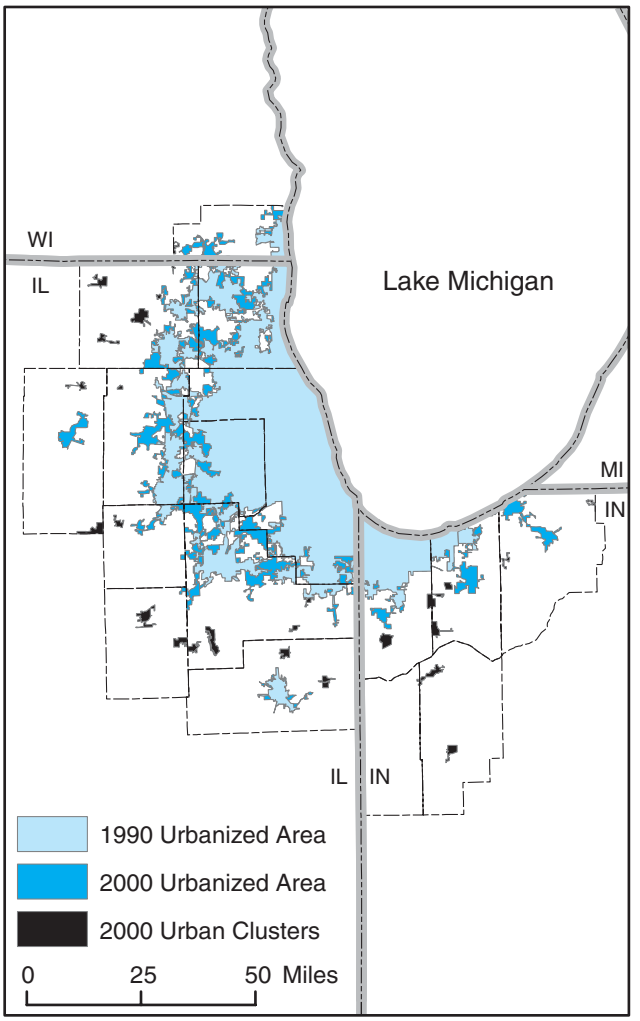


FIGURE 2.14 Chicago urban area in 1990 and 2000 and its urban clusters in 2000.

2.5 CITY AS METROPOLIS

The most prominent metropolitan area concept is based on the U.S. Office of Management and Budget's (OMB's) functional integration principle. According to this principle, metropolitan areas are defined according to the presence of a nucleus and a zone of influence. The *zone of influence* refers to certain standards that outlying counties must meet with respect to their central counties.

The OMB's metropolitan guidelines of 2003 resulted in a 2003 list of metropolitan statistical area (MSA) definitions that

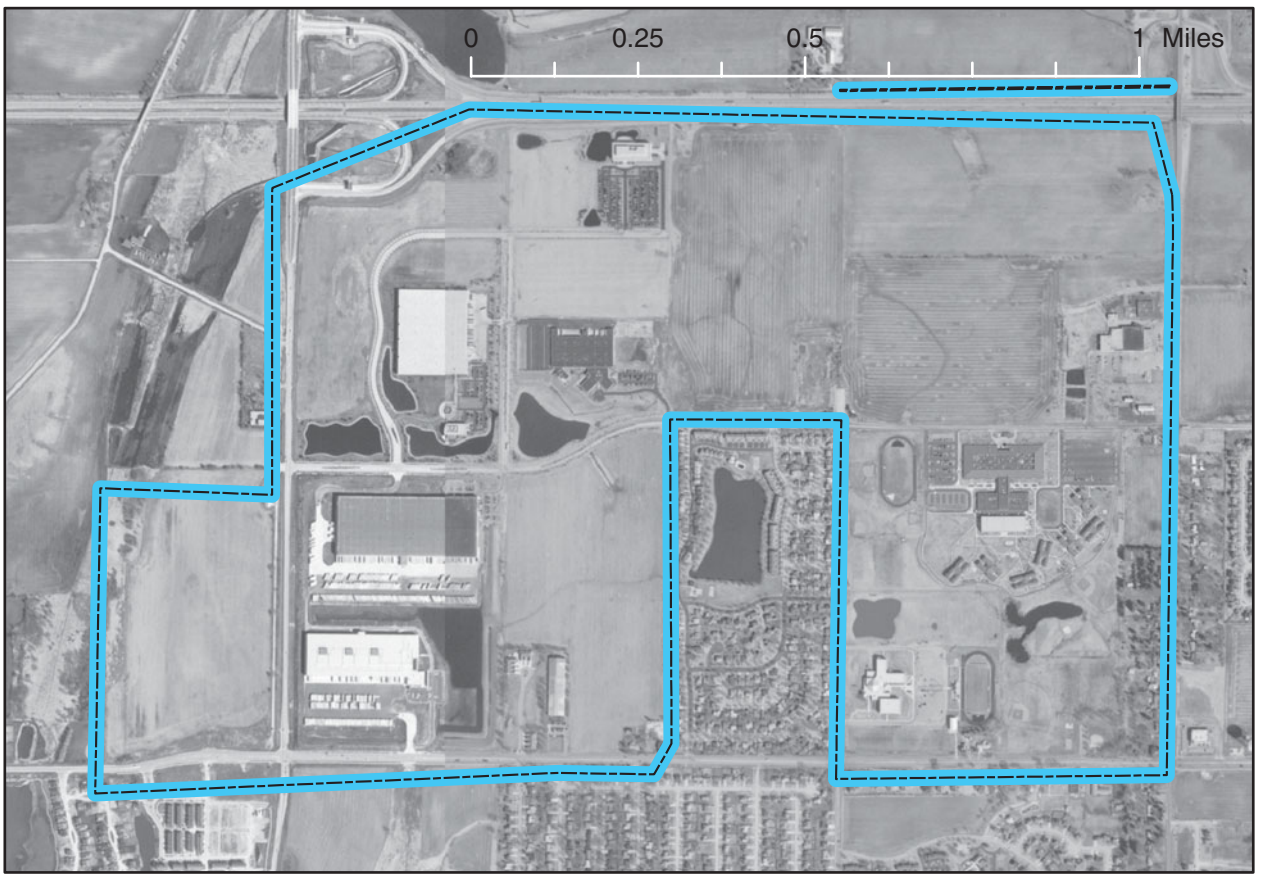


FIGURE 2.15 Aerial photo of section of Aurora, Illinois, included in Chicago's 1990 urbanized area, but excluded in 2000.

were based on commuting data from the 2000 Census (OMB, 2003). There are three primary guidelines in the definition: (1) setting a population size requirement for an MSA, (2) establishing boundaries for the urban nucleus by identifying the central counties, and (3) defining the geographic extent of the influence of the nucleus in the form of outlying counties. Considering size, an MSA has at least one UA. To define the nucleus or the core, a county can be considered central if at least 50 percent of the population is located in the UA. This latter rule would tend to bias the selection of the core counties toward the denser portions of the urban region. Finally, to define the area over which the nucleus extends its influence, outlying counties are identified in terms of their economic and social interaction with the central counties. Commuting flows to and from central counties are the empirical measure of the degree to which central and outlying counties are socially and economically integrated.

A county is considered outlying if at least one-fourth of the working residents of the county work in the central counties or at least 25 percent of the employment in the county is accounted for by workers who reside in the central counties. To illustrate, DeKalb County, Illinois, was once thought too far out from Chicago to be metropolitan, but in the 1990s, it was included in the Chicago metropolitan area because of the large number of workers who commuted inward toward Chicago (see Figure 2.16).

It is important to recognize that commuting, the key determinant of metropolitan inclusion, is defined by where workers live relative to their workplace. If all workers lived near their jobs, there would be little commuting flow between the metropolitan nucleus and outlying areas. For all metropolitan areas in the United States and many in Europe, as well as in developing nations such as Mexico and Brazil, it has become customary to have extensive commuting networks between where people work and where they live. There are, of course, other reasons that people commute besides their work—they sometimes do it for social reasons. However, the work basis for commuting is utilized because censuses and other agencies concentrate on collecting this type of commuting data. In later chapters in this text—especially those on migration and residential mobility, ethnicity, and urban core and edge city contrasts—the changing residential locations of workers versus their job locations will be addressed further. Especially since World War II, there has been a trend for workers to leave the metropolitan nucleus and move out to the suburbs—and in the 1990s even further out to exurbia. *Exurbia* is defined as an area with a high proportion of former urbanites, but far beyond the conventional urban–rural fringe. A key question is, To what extent have jobs moved outward to exurbia as well, and has this tended to reduce commuting levels? The main point for now is to realize that commuting is based on the balance of residence and employment locations.

The formal term for metropolitan statistical areas and micropolitan statistical areas taken together is *core-based statistical*

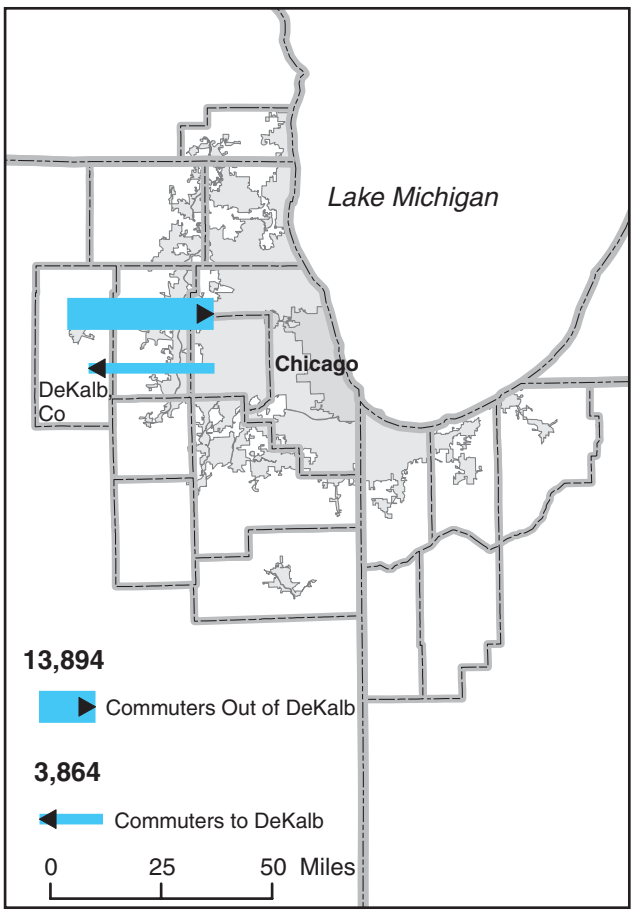


FIGURE 2.16 Commuting flows to and from DeKalb, Illinois, 2000.

area (CBSA). A CBSA includes the county or counties that contain either a UA or a UC, plus adjacent counties having social and economic linkages with the core as exemplified in commuting ties (U.S. Census Bureau, 2010). CBSAs for the western United States are displayed in Figure 2.17. Note in Figure 2.17 that there are three different types of CBSAs: (1) combined statistical areas, (2) metropolitan statistical areas, and (3) micropolitan statistical areas. The combined statistical areas result from the joining of adjacent metropolitan statistical areas that have significant commuting ties with each other. The micropolitan statistical areas contain between 10,000 and 49,999 people and have at least one UC.

2.6 ANALYZING AN URBAN ISSUE: METROPOLITAN DEFINITION

Since the metropolitan concepts originally appeared in 1910, there have been many changes in their definitions. This makes sense because the nation has changed a great deal over the subsequent years with respect to its cities and its urban system. In 2003, the procedures for defining metropolitan areas underwent a significant change, as the inclusion rules for outlying counties were updated to reflect current urban forms. For instance, an outlying county is included in a metropolitan area if it either sends commuters to central counties or receives commuters from central counties. In prior guidelines, greater weight was given to the sending of commuters to central counties, but now the commuter flows are weighted more equally.

The desire to capture the true extent of a city's influence commenced in the 1910 Census with metropolitan districts, which were created for cities of over 200,000. In 1930 and 1940, metropolitan districts were created for cities of 50,000 or more and generally included adjacent minor civil divisions, such as townships and so on, with a population density of 150 or more persons per square mile.

By the 1940s, there was much dissatisfaction with metropolitan district classifications, mainly because the districts were not defined in terms of counties, and that reduced the amount of statistical data available. UAs and standard metropolitan statistical areas (SMSAs) were then conceived for the 1950 Census, the guidelines for which were the predecessors of the 2003 guidelines applied to the Springfield, Missouri, MSA in the GIS exercise at the end of the chapter (see Figure 2.18).

In later years, critics continued to argue that the system was not consistent with the rapid restructuring that was occurring throughout the entire American urban system. One critic went so far as to state that the system was "so arcane, so needlessly complex, so lacking in underlying principle and so afflicted by 'ad hoc-ism' in the selection and modification of criteria for

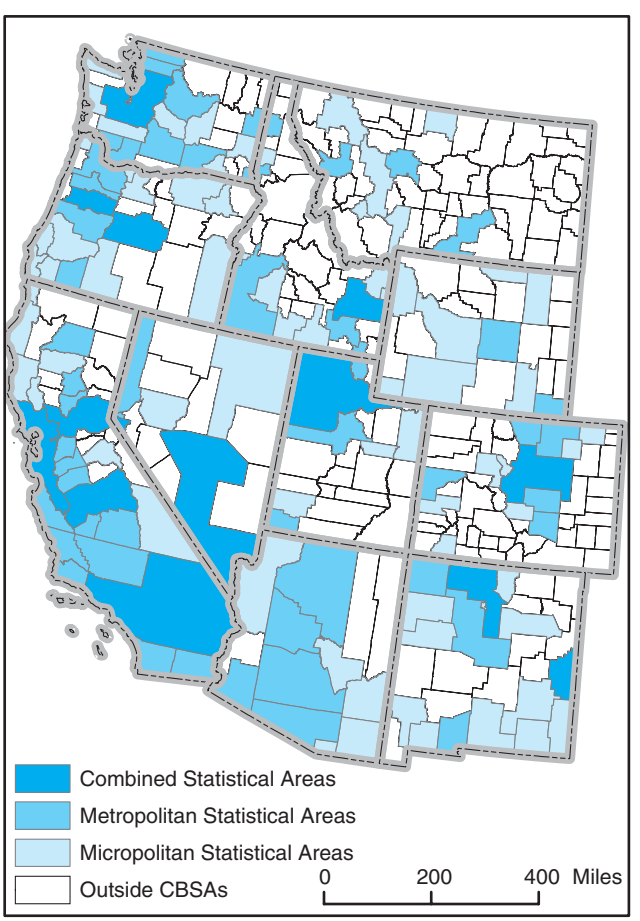


FIGURE 2.17 Core-based statistical areas (CBSAs) for the western United States, June 2003.

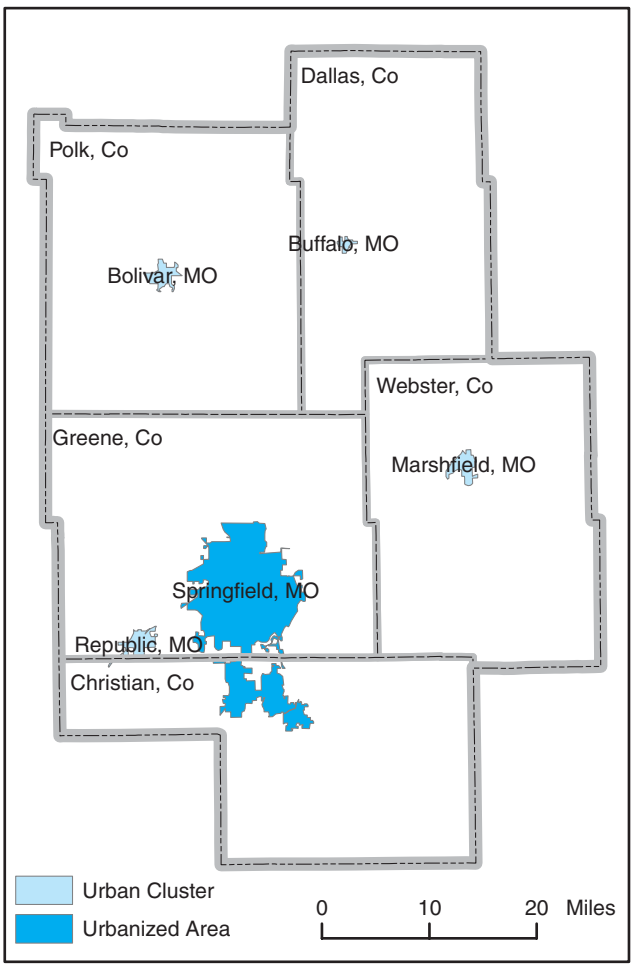


FIGURE 2.18 Springfield, Missouri, MSA, 2000.

inclusion or exclusion of counties in statistical areas as to be ludicrous" (Berry, 1995, pp. 86–87).

Some even questioned the use of journey-to-work in measuring interaction, as it might not be the most significant trip in the modern-day metropolis (Adams, 1995). Others pointed to recent developments in the Internet and communications whereby economic integration of outlying households with the central core can be maintained without ever leaving home.

Prior to accepting the new 2003 rules for defining metropolitan areas, the U.S. Census Bureau commissioned four studies to evaluate the 1990 procedures (Dahmann & Fitzsimmons, 1995). Suggestions from these studies and others were then taken into consideration when developing the procedures for defining MSAs that were implemented in 2003. However, some suggestions were not feasible to implement; for instance, there are no consistent national data on telecommunications links at the city and county levels. Nevertheless, only time will tell if the 2003 guidelines hold up to continually changing urban forms or additional criticisms that might arise.

In 2008, 162.6 million Americans lived in the nation's top 33 MSAs (see Table 2.4). This was 53 percent of the U.S. population of 304.5 million. The largest U.S. combined statistical area was New York–Newark–Bridgeport, with 22.2 million persons. This is an area so big that it extends across parts of four states: New York, New Jersey, Connecticut, and Pennsylvania. In second place was the Los Angeles–Long Beach–Riverside, California, combined statistical area, having 17.8 million people, and the Chicago–Naperville–Michigan City combined statistical area was third at 9.8 million. New York and Los Angeles are the megacities of the United States, according to a cutoff of 10 million. On the basis of U.S. census data given here and a continuation of 2000s growth rates, we project Chicago will join them as a megacity in 2011. Thus, we refer to Chicago in this volume as a megacity, with the understanding that it will likely be one in the 20-teens decade. In the 2000–2008 period, the country's 33 largest MSAs grew at an average yearly rate of 1.11 percent, 0.16 percent faster than the United States as a whole. By comparison, mainland China's four largest cities of Shanghai, Beijing, Guangzhou, and Tianjin are projected to grow during the first decade of the 21st century at an annual rate of 1.80 percent, 1.2 percent faster than China in total (United Nations, 2008; U.S. Census Bureau, 2009). The higher rate of metropolitan growth in the developing world has many ramifications, some of which are examined in Chapters 10 and 11.

The nation's largest MSAs in 2008 were concentrated most heavily in the mid-Atlantic and southern New England states, as well as in Florida and California. The top dozen are mostly in the Northeast, California, Texas, and Florida. This helps us to understand the major routes for economic, transportation, and communication flows. It meant that big metropolitan areas in Pennsylvania, Texas, and Florida were critical battlegrounds for the 2008 presidential race and that those in New York and California, while in Obama's hands early, were big electoral vote contributors.

Understanding the metropolitan concept allows further studies of how metropolitan areas are arranged spatially, what determines their spheres of influence, and what transfers of goods, people, services, and information take place between them.

2.7 OTHER APPROACHES TO DEFINING THE METROPOLIS: MEXICO CITY AND BEIJING

In contrast to the United States, other nations approach the metropolis differently. Their distinctive patterns are the result of topography, urban and political history, and in some cases, the rapidity of population growth. Since it is not possible to cover metropolitan definitions comprehensively, this section considers two large developing-world cities, Mexico City and Beijing, that have unique ways of defining the metropolis.

2.7.1 Mexico City

Mexico has a major urban population, large cities, and expanding metropolitan areas. The concepts of city and metropolitan zone are mostly similar to those in the United States, yet they have differences. For one thing, cities have grown and developed differently in Mexico. A major factor is that new migrants, who are usually poor, tend to arrive at the metropolitan periphery. The more affluent areas of the city are located toward the

TABLE 2.4 33 Largest Metropolitan Areas in the United States, 2008

Rank 2008	Rank 2000	TITLE	Pop. 2000	Pop. 2008	Change	Pct Chg. 2000–2008
1	1	New York–Newark–Bridgeport, NY–NJ–CT–PA, Combined Statistical Area	21,361,797	22,154,752	792,955	3.71
2	2	Los Angeles–Long Beach–Riverside, CA,Combined Statistical Area	16,373,645	17,786,419	1,412,774	8.63
3	3	Chicago–Naperville–Michigan City, IL–IN–WI, Combined Statistical Area	9,312,255	9,793,036	480,781	5.16
4	4	Washington–Baltimore–Northern Virginia, DC–MD–VA–WV, Combined Statistical Area	7,572,647	8,295,397	722,750	9.54
5	5	Boston–Worcester–Manchester, MA–RI–NH, Combined Statistical Area	7,298,695	7,514,759	216,064	2.96
6	6	San Jose–San Francisco–Oakland, CA, Combined Statistical Area	7,092,596	7,354,555	261,959	3.69
7	8	Dallas–Fort Worth, TX, Combined Statistical Area	5,487,956	6,655,261	1,167,305	21.27
8	7	Philadelphia–Camden–Vineland, PA–NJ–DE–MD, Combined Statistical Area	6,207,223	6,398,896	191,673	3.09
9	11	Houston–Baytown–Huntsville, TX, Combined Statistical Area	4,815,122	5,829,620	1,014,498	21.07
10	12	Atlanta–Sandy Springs–Gainesville, GA–AL, Combined Statistical Area	4,548,344	5,729,304	1,180,960	25.96
11	10	Miami–Fort Lauderdale–Pompano Beach, FL, Metropolitan Statistical Area	5,007,564	5,414,772	407,208	8.13
12	9	Detroit–Warren–Flint, MI, Combined Statistical Area	5,357,538	5,354,225	–3,313	–0.06
13	15	Phoenix–Mesa–Scottsdate, AZ, Metropolitan Statistical Area	3,251,876	4,281,899	1,030,023	31.67
14	13	Seattle–Tacoma–Olympia, WA, Combined Statistical Area	3,707,144	4,087,033	379,889	10.25
15	14	Minneapolis–St. Paul–St. Cloud, MN–WI, Combined Statistical Area	3,271,888	3,562,284	290,396	8.88
16	19	Denver–Aurora–Boulder, CO , Combined Statistical Area	2,629,980	3,049,562	419,582	15.95
17	17	San Diego–Carlsbad–San Marcos, CA, Metropolitan Statistical Area	2,813,833	3,001,072	187,239	6.65
18	16	Cleveland–Akron–Elyria, OH, Combined Statistical Area	2,945,831	2,887,492	–58,339	–1.98
19	18	St. Louis–St. Charles–Farmington, MO–IL, Combined Statistical Area	2,754,328	2,879,924	125,596	4.56
20	21	Tampa–St. Petersburg–Clearwater, FL, Metropolitan Statistical Area	2,395,997	2,733,761	337,764	14.10
21	22	Orlando–Deltona–Daytona Beach, FL, Combined Statistical Area	2,191,081	2,718,578	527,497	24.07
22	20	Pittsburgh–New Castle, PA, Combined Statistical Area	2,525,730	2,441,464	–84,266	–3.34
23	23	Sacramento–Arden–Arcade–Yuba City, CA–NV, Combined Statistical Area	2,069,298	2,417,404	348,106	16.82
24	27	Charlotte–Gastonia–Salisbury, NC–SC, Combined Statistical Area	1,897,034	2,338,289	441,255	23.26
25	25	Portland–Vancouver–Beaverton, OR–WA, Metropolitan Statistical Area	1,927,881	2,207,462	279,581	14.50
26	24	Cincinnati–Middletown–Wilmington, OH–KY–IN, Combined Statistical Area	2,050,175	2,198,337	148,162	7.23
27	26	Kansas City–Overland Park–Kansas City, MO–KS, Combined Statistical Area	1,901,070	2,070,544	169,474	8.91
28	28	Indianapolis–Anderson–Columbus, IN, Combined Statistical Area	1,843,588	2,035,327	191,739	10.40
29		San Antonio, TX, Metropolitan Statistical Area	1,711,703	2,031,445	319,742	18.68
30	29	Columbus–Marion–Chillicothe, OH, Combined Statistical Area	1,835,189	2,002,604	167,415	9.12
31		Las Vegas–Paradise–Pahrump, NV, Combined Statistical Area	1,408,250	1,910,121	501,871	35.64
32	31	Milwaukee–Racine–Waukesha, WI, Combined Statistical Area	1,689,572	1,748,818	59,246	3.51
33		Salt Lake City–Ogden–Clearfield, UT, Combined Statistical Area	1,469,474	1,717,261	247,787	16.86

Note: The 2008 metropolitan area populations are estimated by the U.S. Census Bureau. *Source:* U.S. Census Bureau. (2009). *International Data Base.* Washington, DC: Author. Available at *http://www.census.gov*.

city center. Yet the cities have persistently grown outward, and their geographical areas have enlarged. This stems both from the overall higher growth rate of the Mexican urban population, which is due to higher fertility than in the United States, and from the steady migratory streams of Mexicans from rural to urban areas during the 20th century.

The metropolitan area of Mexico City is among the world's largest. It has increasingly spread out over two states, the Federal District in the center and the State of Mexico surrounding it. Following tremendous expansion of the Mexico City metropolitan population and land area since the 1950s, the city has continued to deconcentrate in the center. In Mexico, an urban area (*area urbana*) consists of a central city plus a contiguous area that has buildings and inhabitants, with land use being nonagricultural. The urban, built-up area is physically contiguous in all directions, up to limits where it is interrupted by nonurban land use, such as forests, fields, or water bodies. The urban area contains population that is classified as urban from the geographical, social, and economic perspectives. The definition implies tightly built-up urban territory, leading to an urban area that has an irregular form and does not coincide with the political-administrative boundary of the city, such as that defined by INEGI (*Instituto Nacional de Estadísticas, Geografía, e Informática*) in 2001 (see Figure 2.19). INEGI is the central statistical and census agency for Mexico. Because the urban area is so closely defined by its built-up quality, it is sometimes perceived by Mexican academic experts as an "urban blot or smudge" (*mancha urbana*).

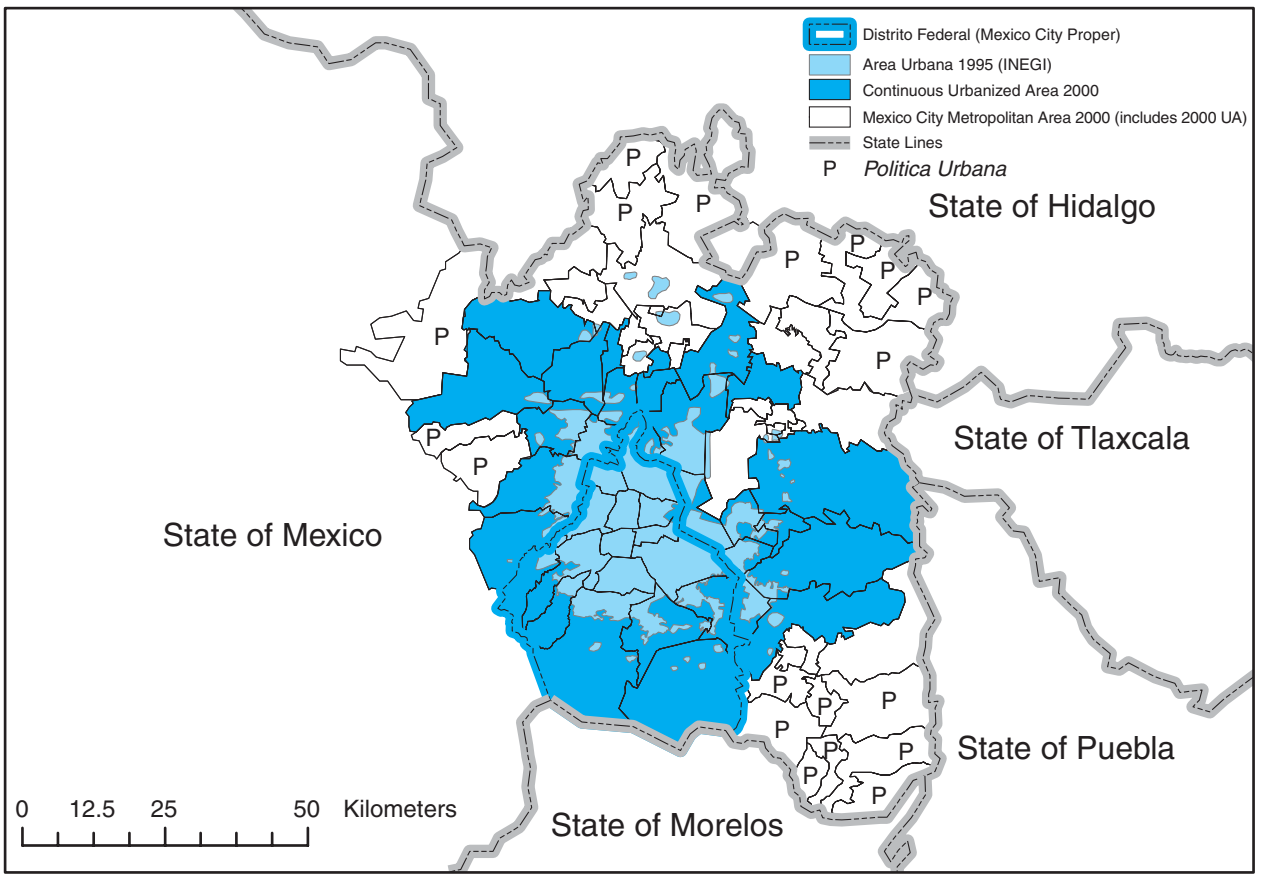


FIGURE 2.19 City, urban, and metropolitan zones of Mexico City.

This urban area concept is similar to the UA or UC in the United States. Like the block groups in the UA or UC, the urban area in Mexico is made up of contiguous *areas geográficas estadísticas basicas* (AGEBs). An AGEB is a basic urban geographic unit built up from city blocks and includes about 2,500 persons. This ensures an urban threshold of about 2,500 persons, which is equivalent to that of the United States.

In the Mexico City area, there are 37 *municipios* included in the continuous urban area defined as just described. Together these define the UA adjusted to administrative boundaries and referred to as the continuous UA in Figure 2.19.

A broader urban concept in Mexico is that of *conurbation*. This is the union of two or more urban areas that have grown very close or are touching each other. These urban areas are in different political-administrative units. Often these urban areas formerly were distinct and have grown together as the Mexico City urban complex has expanded (see Figure 2.20). An example of this conurbation is the coalescence of the Toluca urban area with the Mexico City urban area.

A metropolitan area (*area metropolitana*) in Mexico is defined as territory composed of complete municipios—or a combination of city wards (*delegations*) and municipios for Mexico City. A *municipio* is similar in size to, but somewhat different in concept from a U.S. county. In this textbook, we keep this Spanish word and refer to them as municipios, not translating the term to *counties,* to distinguish them from U.S. counties. A Mexican *municipio* is an incorporated unit having a *municipio* government headed by an elected president, and supported by administrative offices. Although the very largest cities extend over several municipios, most large cities are located in one *municipio,* which serves as the city government.

The outlying metropolitan municipios maintain an intense, daily social and economic interchange with the central city (Figure 2.19). While the U.S. CBSA defines its connections with outlying counties strictly by commuting flows, Mexico defines these connections more broadly. The metropolitan zone in Mexico has smoother boundaries because it is made up of large units; however, it also contains a variety of political-administrative units, including those of the central city, the *municipio* or municipios, and the peripheral towns and cities. The broad variety of administrative units might be one reason that cities in Mexico lack clear-cut planning.

INEGI defined the metropolitan zone of Mexico City in 2000 to consist of 16 city wards in the Federal District plus 58 municipios in the surrounding State of Mexico and 1 in the State of Hidalgo (Figure 2.19). However, 18 of these municipios are included for nonstatistical reasons—for example, for planning purposes or to round out the metropolitan boundary to match an existing state boundary (referred to as *politica urbana* and labeled P in Figure 2.19). The Federal District is one of the 32 Mexican states, but it is special, as it constitutes the seat of the federal government, somewhat like Washington, DC. In 2007, this huge metropolitan zone had a population of 19.0 million (United Nations, 2008). Thus, it was larger in population than all

the U.S. metropolitan areas, as measured in 2007, except for the New York–Newark–Bridgeport combined statistical area.

The Mexico City metropolis has been growing rapidly, especially since the 1950s (see Figures 2.20 and 2.21). It expanded in the 1990s by 18 percent, with nearly all the growth concentrated in the conurbated municipios in the State of Mexico. This growth also reflects an expansion of the territory of the metropolis by the inclusion of more municipios. By contrast, in the 1990s, the three largest U.S. combined statistical areas grew at slower rates—New York at 8 percent, Los Angeles at 13 percent, and Chicago at 11 percent.

Mexico City's metropolitan population of only 3.2 million in 1950 increased to 8.8 million in 1970 and to 19.0 million in 2007. At the same time, the older city, consisting of the Federal District, grew until it peaked at 8.8 million in 1980 and has declined slightly in the three decades since. What is remarkable is the explosive growth of the metropolitan municipios in the State of Mexico in the last 50 years. In Figure 2.20, the conurbation also includes the Toluca metropolitan area in the State of Mexico. With respect to the old city limits of the Federal District, the metropolitan zone has been underbounded; it has leapt over this boundary.

From a geographical standpoint, the metropolitan growth occurred each decade in wider and wider rings of growth, while the city core depopulated. Mexico City's core lost increasing amounts of population from 1960 to 2000. The present core includes both high-rise and low-rise buildings, as seen in Figure 2.22. What is the lesson of this decades-long scenario of outward-moving growth rings and a depleting core? Much of the explanation is that land opportunities were greater and land prices cheaper in the growth rings, so population moved increasingly outward toward them over the years. In addition, during this period the urban core had population densities over 12,000 persons per square kilometer, rising land prices, greater insecurity, and a deteriorating environment, forming push factors to leave the center. Mexico City's private urban developers helped in this process by investing in housing and buildings in these expanding rings to attract and absorb the population.

Another reason for this growth pattern was the attraction of Mexico City's urban periphery for migrants from the rural areas. These migrants moved there because they perceived opportunities to better their life experiences and standard of living. They could not afford to settle closer. In fact, some of them did not purchase the land they settled on, but rather squatted on it. These migrants have been referred to as *parachutists,* meaning that they dropped in, landed, and claimed their land.

An important effect of the expanding rings has been the development and problems of transportation in the metropolis. Mexico City suffers from a deficit in major highways. Its major freeway, termed the *Periferico,* was built in the 1960s when the city was much smaller, and it is inadequate for current commuting flows. There are major traffic stoppages nearly every day during peak commuting times. In the early 2000s, the Mexico City government built a second story on parts of the *Periferico,*

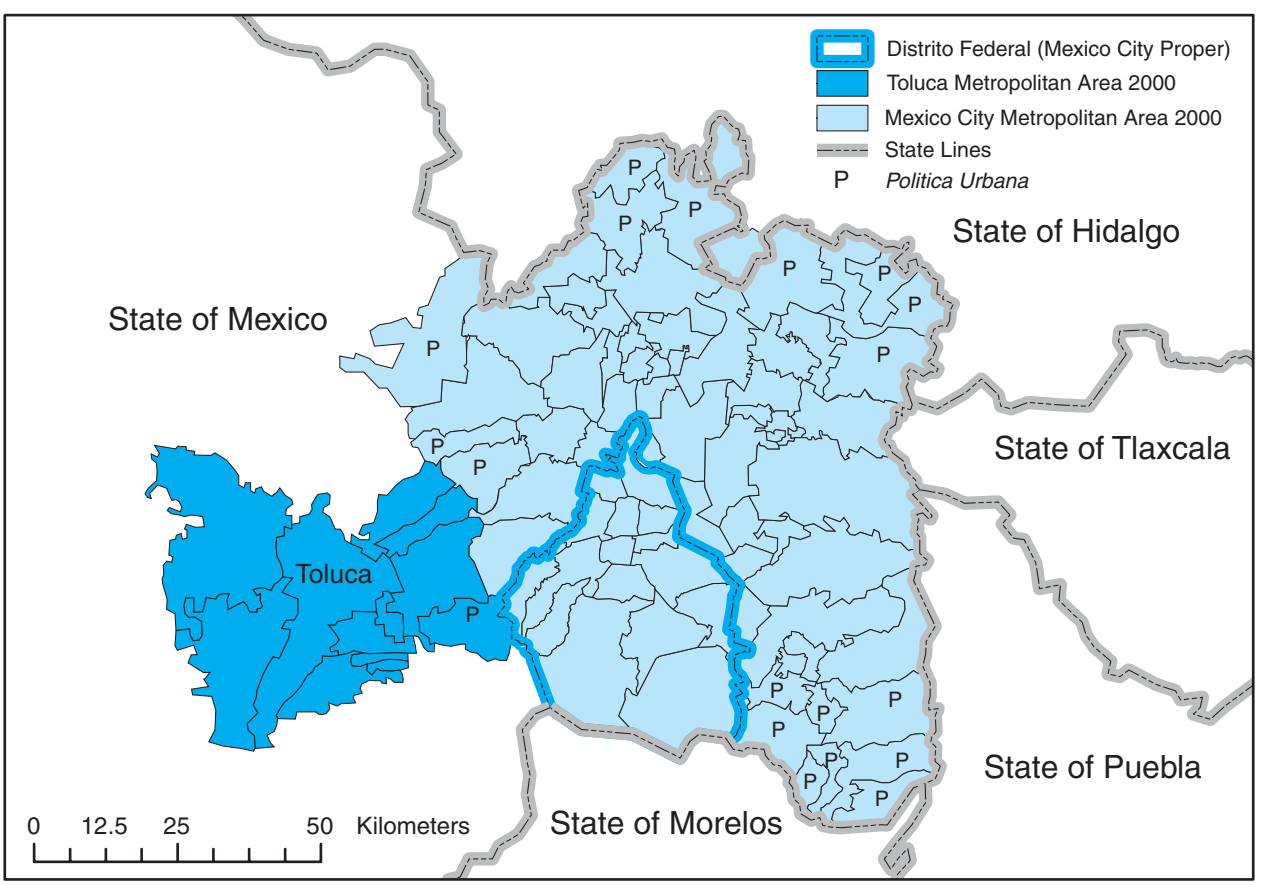


FIGURE 2.20 Mexico City and Toluca conurbation, 2003.

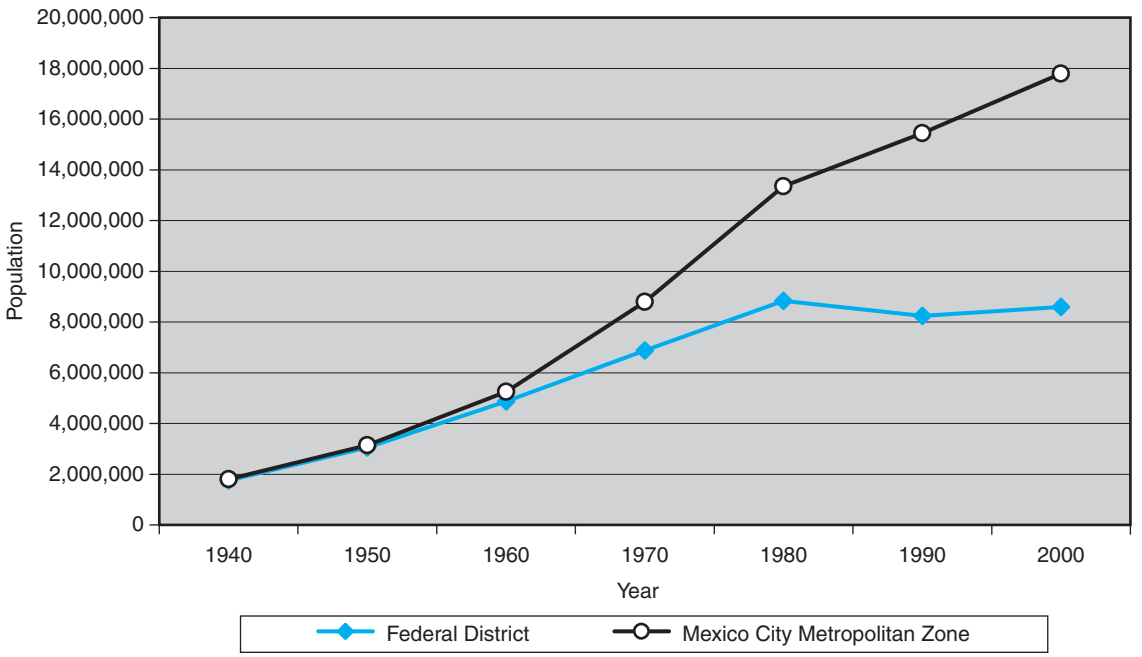


FIGURE 2.21 Population of Mexico City metropolitan zone, 1950 to 2000. *Source: Instituto Nacional de Estadísticas, Geografía, e Informática.* (2001). *Estadísticas del Medio Ambiente del Distrito Federal y Zona Metropolitana 2000*. Aguascalientes, Mexico: Author.

which offers some relief. Because the major employment centers remain concentrated in the urban core (Pick & Butler, 2000), the pressure continues. One response is the large number of commercial minibuses in the metropolis, which carry millions of commuters every day, but are inefficient and serious sources of pollution. The Mexico City subway, which is old and overcrowded, is heavily utilized as well. There are also small-scale commuting patterns, which apply especially to the lower classes in Mexico City. They do not tend to commute long distances and mostly use public transport, especially inexpensive minivans and the subway.

The Mexico City metropolis also has natural features that have been in interplay with the massive metropolitan growth of the last decades. Five hundred years ago the Aztec city was

FIGURE 2.22 Mexico City core.

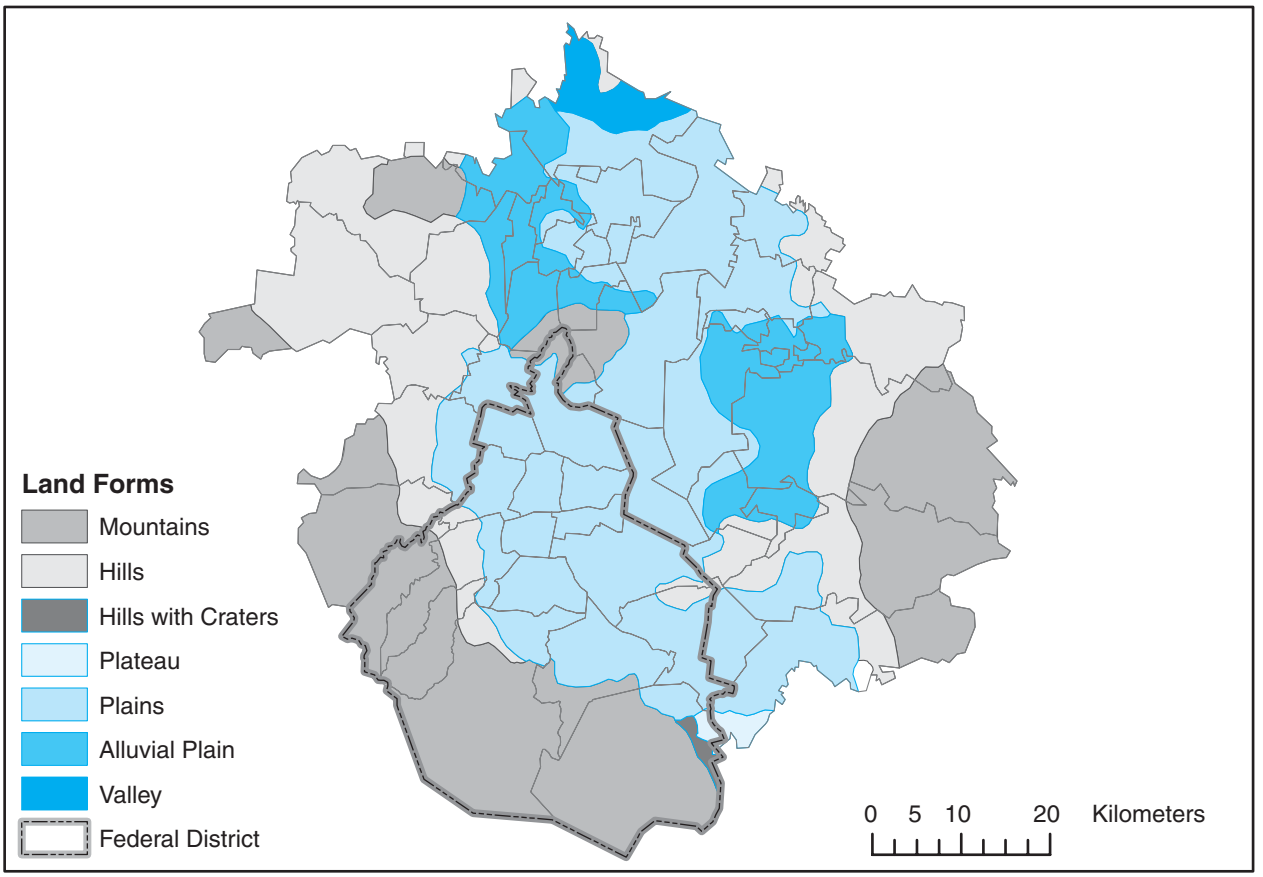


FIGURE 2.23 Mexico City and its natural regions. *Source: Instituto Nacional de Estadísticas, Geografía, e Informática.* (2001). *Estadísticas del Medio Ambiente del Distrito Federal y Zona Metropolitana 2000*. Aguascalientes, Mexico: Author.

originally set in a huge shallow lake with rich forest ecosystems surrounding it. Its natural setting then and now is one of towering volcanoes to the south and southwest, mountains to the west, and a high plain stretching to the north across the State of Mexico and beyond. The ancient lake has mostly dried up, but residuals of the lake remain in the northeastern part of the Federal District and in the east, including Texcoco.

Metropolitan growth has caused major losses to the forests and other biota of the metropolitan region. The discussion of the natural setting here considers how the natural features have been barriers that influence the metropolitan distributions, shapes, and human densities. This discussion is helpful because any city or metropolitan area interacts with and adjusts to its natural features in its development.

The natural regions of Mexico City are shown in Figure 2.23. The huge snow-capped volcanoes of Popocatepetl and Ixtaccihuatl and the surrounding mountainous regions are included in a semicircle that extends to the southwest, south, and southeast. These areas are not very habitable and even less so because of volcanic activity in recent years in Popocatepetl. In the middle and north of the Federal District and extending northward through the State of Mexico is an area of plains. This area is the most habitable and also forms a corridor for future growth. It is broken up at the tip of the Federal District and to the northwest by several smaller volcanic mountain regions. The large hills to the east and west of the plains are also barriers and have not had much habitation.

The example of Mexico City emphasizes that natural barriers can influence urban settlement patterns and can point a metropolis in certain directions for future expansion.

2.7.2 Beijing

The Beijing metropolitan area is distinctive in comparison to U.S. cities, Tokyo, and Mexico City. As we have seen, American cities, Tokyo, and Mexico City have city or municipal boundaries to the political-administrative urban core, yet much of the built city falls outside the city limits. What is remarkable about Beijing and other mainland China cities is that the municipal boundaries are much more extensive than the urban area and often include substantial amounts of rural land. As seen in Figure 2.24, the city of Beijing proper consists of 16 districts, which include large amounts of rural land. The Beijing municipality encompasses two additional, largely rural counties of Yanqing and Miyun. This area of city administration includes both districts and counties and extends over 16,808 km^2, or 6,492 square miles.

The central city consists of the districts of Dongcheng, Xicheng, Chongwen, and Xuanwu, seen in the middle of Figure 2.25. Xicheng is the core district, the focal point of

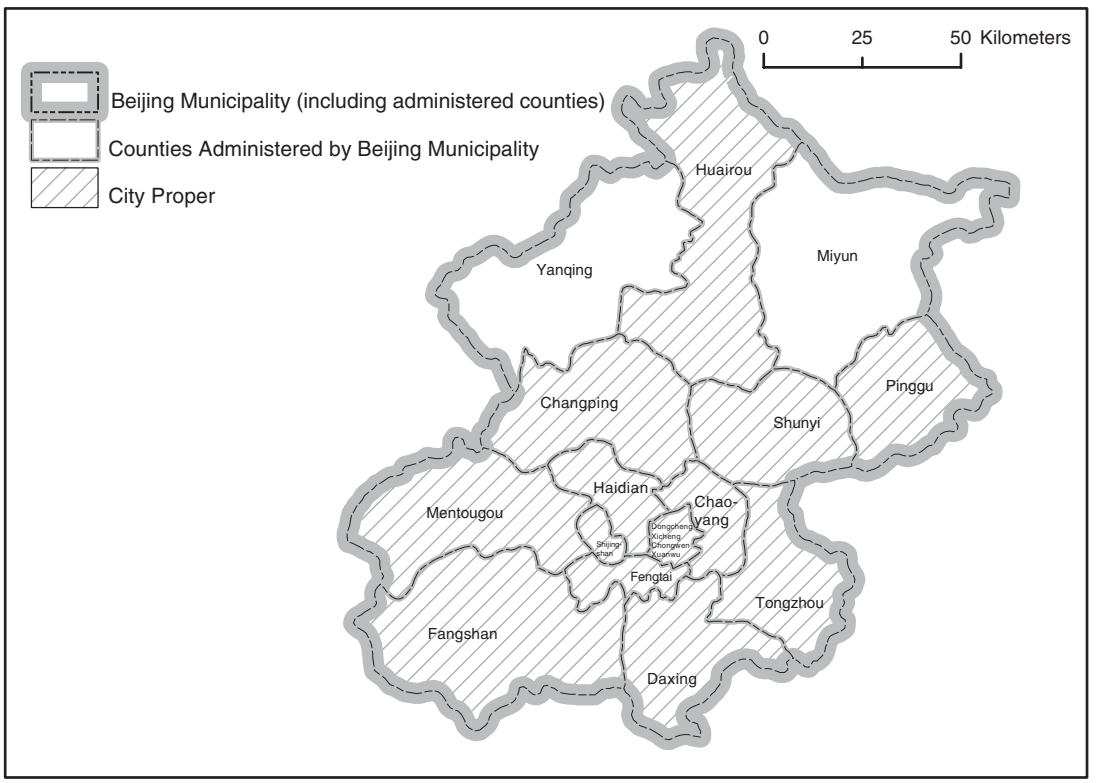


FIGURE 2.24 Beijing metropolitan area, 2003: Official definitions.

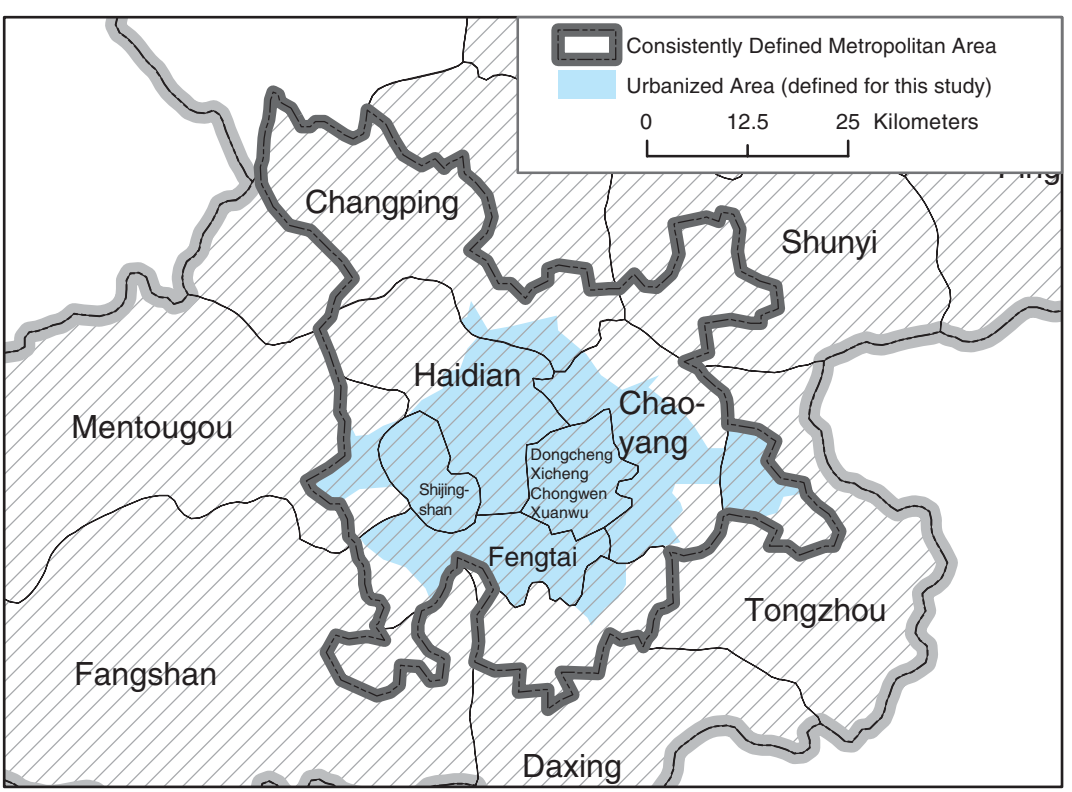


FIGURE 2.25 Beijing metropolitan area, 2003: Consistently defined metropolitan area definitions.

which is the Forbidden City, which was for centuries the palace of the Chinese emperors. Today, it is the Palace Museum, which houses many of China's greatest cultural treasures. Immediately adjacent to the Forbidden City is Tiananmen Square, which contains Mao's Tomb and on one side adjoins the Great Hall of the People, the legislative and ceremonial hall for the nation and its Communist Party. Other major government department, military, and top leadership offices are nearby.

The Forbidden City is encircled by six Ring Roads, four of which are seen in Figure 2.26. The Ring Roads represent the successive expansion of the city and today constitute its major circular traffic arteries. Several major highways radiate outward from the center, crosscutting the Ring Roads to complete the major highway network. Traffic built up substantially in the 1990s and 2000s due to China's economic boom and its increasing market for personal automobiles, so traffic congestion has become a serious urban problem, with the biggest bottlenecks on the crosscutting arteries.

The present Beijing urban agglomeration, with a 2010 population estimated by the United Nations at 11.7 million (United Nations, 2008), represents a global metropolis that has been transformed from the poor, compact, and plain-looking city it was at the birth of the People's Republic of China in 1949. The four central districts of Dongcheng, Xicheng, Chongwen, and Xuanwu correspond to the area of the city around 1950. During the period of Supreme Leader Mao Tse-tung (1949–1976), there was a command economy in which Beijing grew in industrial production, but not in commerce and services. City architecture shifted from the traditional courtyard residences (*hutongs*) and low-rise buildings to large buildings derived from Stalin-era design. The rings of city walls dating from the empire were demolished, giving rise to the Ring Roads (Williams & Chan, 2008).In the period since the end of the 1970s, market reforms were introduced, commerce and services grew, sophisticated tourist and entertainment amenities were added, and foreign investment and foreigners arrived. Beijing developed cutting-edge science and technology, increasingly at a global level, that was centered in the Hadian District, seen in Figure 2.26 to the east of the Forbidden City between the third and fourth Ring Roads. It is nearby to China's leading universities—Peking, Tsinghua, and Renmin—and has attracted thousands of high-tech enterprises and support services. The economic prosperity, sophistication, culture, and educational strength of Beijing constitute an attraction for rural migrants, and millions have arrived over the past two decades. Often they lack a residence permit (*hukou*) to live in the city, so they are referred to as "floating population"; they have access to limited services and rights. Many have settled in poor communities of mainly migrants located at the urban fringe, such as Zhejiang Village and Xinjiang Village (Williams & Chan, 2008). At the other extreme, wealthy Chinese who have benefited from the economic expansion and foreigners have located in upscale areas such as developments of remodeled *hutongs,* fancy apartment buildings near the city core, or Western bungalow–style detached homes located at the urban fringe (Williams & Chan, 2008).

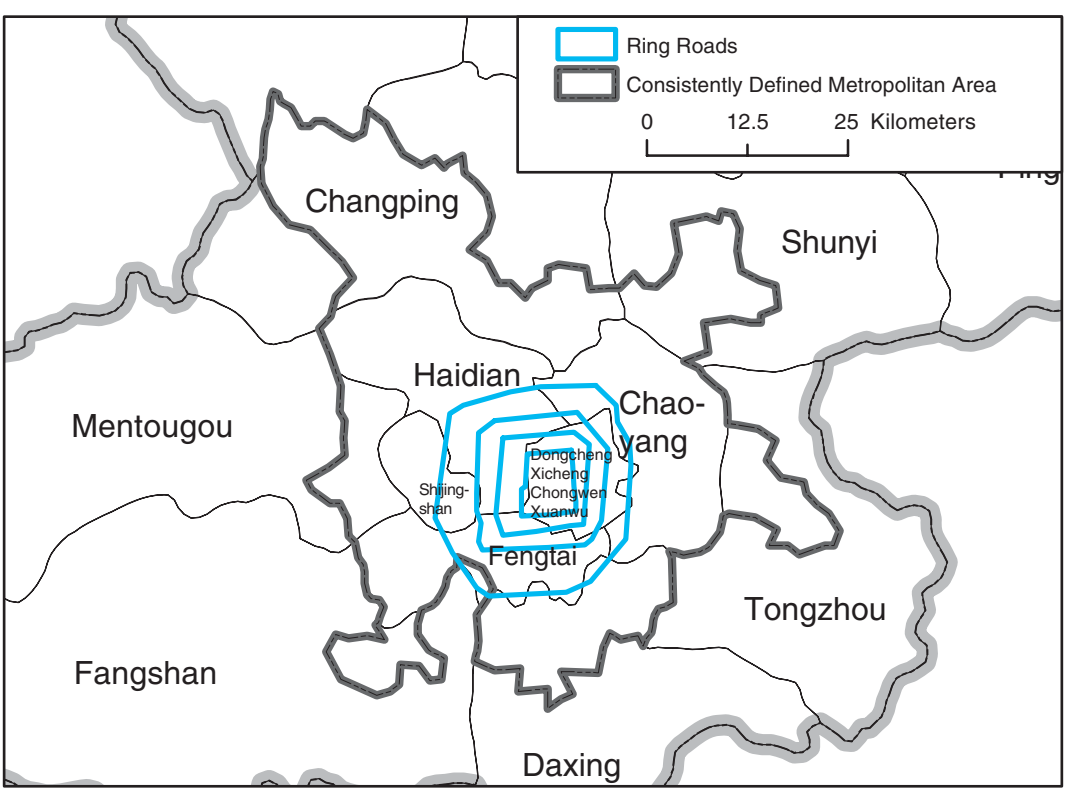


FIGURE 2.26 Beijing metropolitan area, 2003: Ring Roads and consistently defined metropolitan area.

In summary, the megacity of Beijing is a complex blend of tradition, communist government political power, culture, education, modernized business and commerce, and poor migrant zones. Beijing extends outward in the increasingly built-up network of Ring Roads. The full municipality area in Figure 2.24 is vast and includes substantial rural land. Beijing is unusual in that it reverses the world standard pattern of municipality limits, so instead of bounding the urban core, they delimit the further extent of the metropolis.

2.8 MEGA-REGIONS AND THEIR IMPACT

Megacities, those with metropolitan populations of 10 million or more, were introduced in Chapter 1. They were seen to be increasing in number and shifting in proportion from the developed to the developing world (Zlotnik, 2004). In this chapter, two examples of megacities, Mexico City and Beijing, were examined based on more detailed urban definitions and with the help of the GIS.

The mega-region, a much larger concept than the megacity, is gaining interest in urban geography and urban studies (Florida, 2008; Florida, Gulden, & Mellander, 2008; Hall & Pain, 2009; Laquian, 2005; Zheng, 2009a, 2009b). This larger entity is defined as "integrated sets of cities and their surrounding suburban hinterlands across which labor and capital can be reallocated at very low cost" (Florida, Gulden, & Mellander, 2008, page 459). The history of the mega-region concept stems from Gottman (1957), who identified the Boston-to-Washington complex of urban areas as a single megalopolis (Morrill, 2010). Today, the term *megalopolis* has been succeeded by *mega-region*.

In formation of a mega-region, several megacities and/or large metropolitan areas expand into each other and/or have adjoining borders with common hinterlands. Alternatively, a megacity might grow and annex surrounding cities, as occurred with Tokyo's annexation of Yokohama. Mega-regions might extend across international borders and be located in two or more nations. A mega-region can have population of over 100 million and annual economic product of over $1 trillion.

Among the challenges of the mega-region concept are how to determine its geographical extent and how to aggregate data on its social, economic, and cultural characteristics. These tasks need to be done on a worldwide basis so a mega-region in Africa could be compared with one in North America or Asia. One approach is to utilize national census statistics and make adjustments so the mega-regions are determined in a comparable way. Another approach is to utilize a combination of population density and a ratio of nonagricultural employment to identify the mega-region's land extent (Zheng, 2009a, 2009b).

A novel approach is to utilize satellites to measure the light that is emitted at night, which can be done using small mapping grid cells of the world's land area (Florida, Gulden, & Mellander, 2008). A threshold level of light determines whether or not a grid cell is classified as within a mega-region. The extent of mega-regions can be determined by combining contiguous urban grids (Florida, Gulden, and Mellander, 2008). By calibrating the amount of light emitted with population, economic activity, and innovation indicators (patents or leading scientific authors), estimates can be made of a mega-region's population, economic output, and innovation. Findings from this approach for the world's 20 largest mega-regions, based on estimated regional product in billions of dollars and seen in Table 2.5 (Florida et al., 2008), show that the following 7 mega-regions have light-based regional economic product (LRP) over $1 trillion: Greater Tokyo, Boston–Washington, Chicago–Pittsburgh, Amsterdam–Brussels–Antwerp, Osaka–Nagoya, and London–Leeds–Manchester. These hugely productive mega-regions are all from the developed world. The only developing-world mega-region in the top 20 in terms of LRP is Mexico City, with a LRP of $290 billion.

The mega-regions are ordered differently for population. For instance, the Delhi–Lahore mega-region ranks number 1 in population, at 121.6 million, but is 35th in LRP, at $160 billion. The center of the Delhi mega-region is seen in Figure 2.27 on page 66. Shanghai is the second most populous mega-region, but is 31st in LRP rank. The innovation rankings have a different ordering that points toward some mega-regions with creativity far beyond their population size—particularly Northern California, Toronto–Buffalo–Rochester, Paris, and Charleston–Atlanta (Florida et al., 2008). In overall creativity, the leaders are Boston–Washington, Northern California, and Chicago–Pittsburgh. Mega-region innovation and creativity are much reduced in the developing-world mega-regions such as Mexico City, Delhi–Lahore, and Rio–Paulo, which are ranked below nearly all of the mega-regions in developed countries. However, some of the developing-world regions such as Shanghai are improving significantly in innovation. In Chapter 11, the technology section seeks to explain this gap further, which is sometimes termed *digital divide*.

The light-based method has weaknesses such as not measuring on-the-ground economic flows and ignoring cultural and political differences in light emissions. However, it does measure light consistently worldwide, and it gets around the legacies of old urban administrative boundaries in many countries. The method helps in roughly identifying mega-regions and might be strengthened by more elaborate future urban geography studies.

From the limited, but expanding knowledge of mega-regions, several major results have already emerged:

1. Many mega-regions have extensive land area and might spread across several countries (Florida, Gulden, and Mellander, 2008).
2. Mega-regions have concentrated economic activity that is tied to globalization (Zheng, 2009a).
3. The most economically productive mega-regions are estimated to have economic products roughly equivalent to those of major developed nations such as Canada, France, and Italy (Florida, 2008).
4. The urban fringes of mega-regions often have rural areas that are in the process of losing their rural aspects. Since they are away from metropolitan centers, these transitioning areas are often viewed by governments as still rural and hence are provided minimal metropolitan infrastructure and services (Zheng, 2009a).

TABLE 2.5 World's 20 Largest Mega-regions from Light-based Regional Product (LRP), with 5 Other Populous Mega-regions

Mega-region	Population (millions)	Population Rank	LRP 2000 ($billion)	LRP Rank	Patents (2001)	Patent Rank	Top Scientific Authors (2001)	Top Scientific Authors (Rank)
Greater Tokyo	55.1	4	2,500	1	91,280	1	11	16
Bos–Wash	54.3	5	2,200	2	21,307	3	293	1
Chi–Pitts	46	9	1,600	3	17,686	4	67	5
Am–Brus–Twerp	59.3	3	1,500	4	6,985	9	29	11
Osaka–Nagoya	36	14	1,400	5	15,897	5	9	20
Lon–Leed–Chester	50.1	6	1,200	6	3,315	14	89	3
Rom–Mil–Tur	48.3	7	1,000	7	4,000	33	12	14
Char–lanta	22.4	18	730	8	4,188	11	49	7
So Cal	21.4	22	710	9	6,902	19	74	4
Frank–Gart	23.1	17	630	10	3,199	15	39	8
Barce–Lyon	25	16	610	11	1,896	23	10	17
Tor–Buff–Chester	22.1	19	530	12	3,402	12	56	6
Seoul–San	46.1	8	500	13	21,833	2	0	40
Nor Cal	12.8	28	470	14	11,567	6	108	2
So Flo	15.1	25	430	15	2,693	19	8	22
Fuku–kyushu	18.5	24	430	16	1,965	21	9	20
Paris	14.7	26	380	17	9,007	8	16	13
Dal–Austin	10.4	30	370	18	3,149	17	16	13
Hou–Orleans	9.7	32	330	19	2,724	18	30	10
Mexico City	45.5	10	290	20	91	35	0	40
Five other populous mega-regions								
Rio–Paulo	43.4	12	230	22	457	30	0	40
Hong–Zen	44.9	11	220	23	2,231	20	1	31
Shanghai	66.4	2	130	31	988	27	0	40
Beijing	43.1	13	110	34	1,582	25	0	40
Delhi–Lahore	121.6	1	110	35	160	36	0	40

Source: Florida, Gulden, and Mellander. (2008). "The rise of the mega-region." *Cambridge Journal of Regions, Economy and Society* 1:469, Table 3.

5. Some of the largest mega-regions, including Tokyo and Delhi, have so far lacked comprehensive mega-region planning, which has resulted in such problems as economic inefficiencies, traffic bottlenecks, and environmental deterioration (Laquian, 2005).
6. The inner core areas of developing-world mega-regions can be redeveloped to become vibrant and productive (Laquian, 2005).
7. Outlying and fringe areas can benefit economically from planned "new towns," high-tech parks, and satellite cities. An example is the Chinese-government-sponsored development since 1988 of high-tech parks in China, about two-thirds of which are located in the country's largest mega-regions (Laquian, 2005).
8. Some mega-regions, especially in the developing world, have low average per capita economic productivity, which highlights the issues and challenges in reducing poverty and unemployment, rectifying social problems, improving housing, and enhancing life chances in impoverished parts of these regions (Baud, Sridharan, & Pfeffer, 2008; Laquian, 2005).
9. A disproportionate amount of worldwide innovation and creativity occurs in certain larger mega-regions in highly developed countries, such as London–Leeds–Manchester in England and Northern California (Florida, 2008; Florida, Guilden, & Mellander, 2008).

Mega-regions constitute an important emerging area of urban geography that will be elucidated by further study of them around the world. They constitute the largest and most productive urban agglomerations covered in this textbook. They also present some of the most urgent and difficult urban problems and planning challenges.

FIGURE 2.27 Delhi mega-region: Street scene in downtown.

Summary

Urbanized areas, cities, and metropolitan areas form key elements of urban geography. Most countries define urban places, at least in part, as places larger than a specified minimum size. The metropolitan concept is focused on central areas that are connected through commuting and other social, transport, and economic linkages to peripheral areas. Overall, the metropolis is less tightly defined than the UA. Both urbanized areas and metropolitan areas are associated with administrative and government units. However, the definitions are based not on government, but rather on agglomerations of people. In many cases, there is a poor fit between the government arrangement in space and the ability to govern a city or metropolitan region well.

Metropolitan areas are not isolated, but form systems nationally and regionally. The metropolises interact with each other through spheres of influence, transport, trade, migration, and communications. The chapter exercise applies spatial analysis to examine commuting exchanges. Many other models exist to try to account for city and metropolitan interchanges.

Mega-regions are the largest urban geographic unit and rival many nations in size and economy. Study of them is evolving and has potential importance for planning.

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Exercise

Exercise Description

Illustrating a variety of urban definitions for Tokyo and a smaller U.S. metropolitan area, Springfield, Missouri.

Background Information

In the first part of this lab, you examine multiple definitions for Tokyo. In the second part, you examine the method used by the U.S. Census Bureau to define a metropolitan area. The metropolitan area concept is an important urban concept because it represents the broad geographic region that is influenced by a city. You will be working with the Springfield, Missouri, MSA to determine how its core and outlying counties were determined.

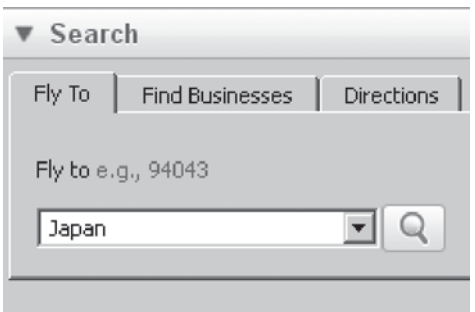
Course Concepts Presented

Metropolitan statistical area, urbanized area, urban cluster, central county, outlying county, commuting.

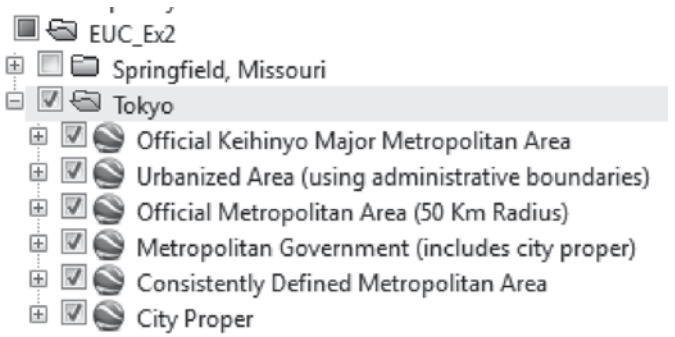
Google Earth Version

Tokyo Definitions

1. Launch the Chapter 2 Google Earth KMZ file by double-clicking it:
   EUC_Ex2.kmz
   We should first zoom into all of Japan to see where Tokyo is situated within that country. Use the Fly To tool to zoom to Japan.



   Japan extends from Sapporo in the northeast to some smaller islands extending almost to Taiwan's Taipei in the southwest. Tokyo and Yokohama are close to the middle of this extensive island nation.
2. In the Table of Contents on the left-hand side, expand Tokyo under EUC_Ex2 under Temporary Places under Places. Then double-click Tokyo to zoom there.



3. Turn on the City Proper layer, and expand it to show Features. Double-click the polygon symbol below Features to zoom to Tokyo City Proper.

   Click on the information point on the map or the 1 next to the polygon symbol to reveal the population and annual change information for Tokyo City Proper.

   Tokyo Question 1: What was the population of the city of Tokyo in 2000?

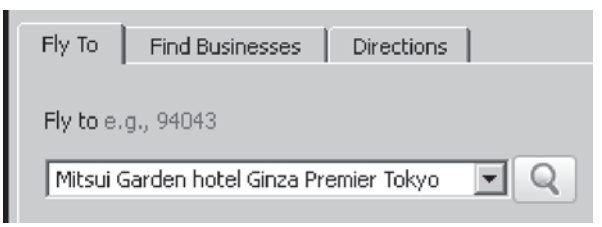
   Tokyo Question 2: What is the annual average population change in the city of Tokyo?
4. Next turn on and expand the Urbanized Area layer. Double-click Features to zoom to the urbanized area.

   Tokyo Question 3: What was the population of Tokyo's urbanized area in 2000?
   Tokyo Question 4: What is the annual average population change in Tokyo's urbanized area?
5. Next turn on and expand Official Keihinyo Major Metropolitan Area. Double-click Features to zoom to the major metropolitan area.

   Tokyo Question 5: What was the population of Tokyo's major metropolitan area in 2000?

   Tokyo Question 6: What is the annual average population change in Tokyo's major metropolitan area?
6. Save the map to a file to submit with your essay later by clicking File, Save, and Save Image. Navigate to where you want to save the file, and give it a name (e.g., TokyoDefinitions.jpg).
7. Explore downtown Tokyo to see what a downtown looks like in a city of 30 million people.

   One way to get to the downtown quickly is to go to a well-known place like the Mitsui Garden Hotel Ginza Premier Tokyo.



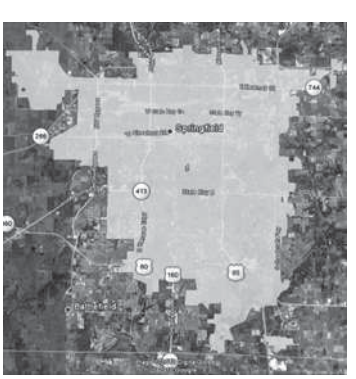
8. Turn on 3D Buildings under Primary Database under Layers in the Table of Contents on the left-hand side. Continue zooming in and out, as well as viewing camera images, until you can make sense of the downtown. Tilt the globe and print the map to a file. Save the file by clicking File, Save, and Save Image.

   Navigate to where you want to save the file, and give it a name (e.g., TokyoDowntown.jpg).

   Tokyo Question 7: What are your thoughts about downtown Tokyo?

Springfield, Missouri, Definitions

9. Uncheck Tokyo to turn off the Tokyo map layers, and expand Springfield, Missouri. Turn on Springfield Municipal Boundary, and double-click it to zoom to it.



Springfield Question 1: Which of the three concepts of the city from this chapter does this layer represent?

Springfield Question 2: Examining the aerial photograph along the edge of Springfield, can you see any evidence that would suggest it is either an underbounded or an overbounded city? Give your argument for underbounded or overbounded. *Note:* To temporarily see the satellite imagery within the municipal boundary, unclick Springfield Municipal Boundary.

Springfield Question 3: What is the 2000 population of Springfield?

10. Turn off all layers except Urban Areas and Clusters, and double-click to see it.

Springfield Question 4: Which of the three concepts of the city does this layer represent?

Springfield Question 5: What is the 2000 population of the Springfield urbanized area?

According to Section 1 of the OMB guidelines for defining CBSAs, each CBSA must have a Census Bureau–defined UA of at least 50,000 people or a Census Bureau–defined UC of at least 10,000 people (UAs and UCs are referred to collectively as urban areas).

Expand Features, and double-click each of the urban areas to zoom to it. Record their 2000 populations below.

Bolivar =
Buffalo =
Marshfield =
Republic =
Springfield =

Springfield Question 6: Which urban area(s) qualified as the core(s) of the Springfield metropolitan area? Reread Section 1 of the OMB guidelines above and you can determine the answer.

11. Turn on the Springfield MSA Counties layer.

According to Section 2 of the OMB guidelines, the central county or counties of a CBSA are those counties that (a) have at least 50 percent of their population in urban areas with a population of at least 10,000 or (b) have within their boundaries a population of at least 5,000 located in a single urban area with a population of at least 10,000.

Springfield Question 7: Only two counties can possibly qualify as central counties because only two of them geographically intersect the Springfield UA. To see the UA, check all the Springfield urban area features under Urban Areas and Clusters. To also see the counties, check Springfield MSA Counties. The county names appear at the information points. Which two counties are central?

Springfield Question 8: The population of Greene County that lives in the Springfield UA equals 188,252, whereas 26,466 of Christian County's population live in the same UA. Under which part of Section 2 (a or b) do these counties qualify as central counties?

12. Keep the Springfield MSA Counties layer turned on.

According to Section 3 of the OMB guidelines, a county qualifies as an outlying county of a CBSA if it meets one of the following commuting requirements: (a) At least 25 percent of the employed residents of the county work in the central county or counties of the CBSA, or (b) at least 25 percent of the employment in the county is accounted for by workers who reside in the central county or counties of the CBSA.

We can test the requirement in subsection (a). In the Table of Contents, under the Springfield MSA Counties layer, make sure that Information Points is checked, and then click the "i" symbols on the map for Dallas, Polk, and Webster Counties to get the count of the total workers living in each of those counties (referred to as resident workers). Also see the number of workers that they send to Christian and Greene Counties.

Springfield Question 9: Compute the percentage of the resident workers from Dallas, Polk, and Webster Counties that commute to Christian and Greene Counties. You can compute the following for each of the three counties:

(Work in Christian Co+Work in Greene Co)/Total Workers

Do these three counties qualify as outlying counties under subsection (a) of Section 3 of the OMB guidelines?

13. Turn off all layers except Springfield Metropolitan Statistical Area.

Springfield Question 10: What was the 2000 population of the Springfield MSA?

Google Earth Short Essay: Compare and contrast the urban definitions for Tokyo, Japan, and Springfield, Missouri. How do these definitions differ? Indicate any weaknesses you see for the urban definitions of Tokyo and Springfield. You can zoom and check camera images to support your arguments on weaknesses in urban definitions. Include several maps or images to support your essay arguments.

ArcGIS 10 Version

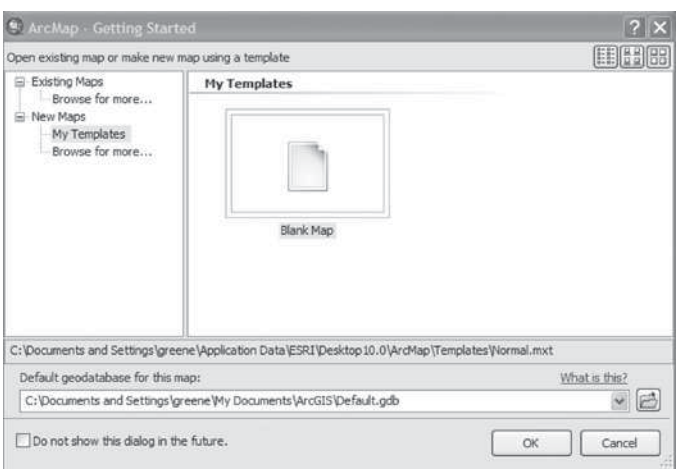
Introduction

The U.S. Census Bureau's 2003 definition of the Springfield, Missouri, MSA is a five-county area centered on the city of Springfield. Using the official guidelines for defining MSAs (see metro_micro_procs.pdf in the Exercise folder), we will use a GIS to replicate the definition. The exercise completes only the first three sections of the guidelines, those that relate to identifying the population requirements for urban areas, establishing central counties, and establishing outlying counties.

Population Size Requirements for Qualification of CBSA
Refer to page 10 of the metro_micro_procs.pdf document. Each CBSA must have a Census Bureau–defined UA with a population of at least 50,000 or a Census Bureau–defined UC with a population of at least 10,000 (UAs and UCs are collectively referred to as urban areas). MSAs are one type of CBSA, while micropolitan statistical areas are the second type.

1. Start ArcMap

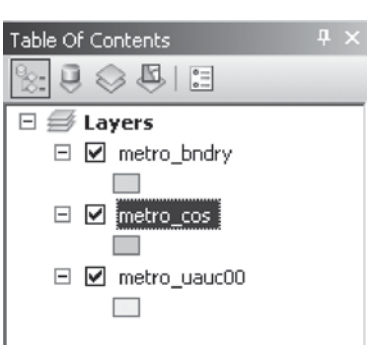
2. Under New Maps, click My Templates, and then double-click the Blank Map template.



3. Click the Add Data button, and navigate to the exercise data folder.

Note: If you do not see the folder where you placed the exercise data, you will need to make a new connection to the root directory that holds the data.

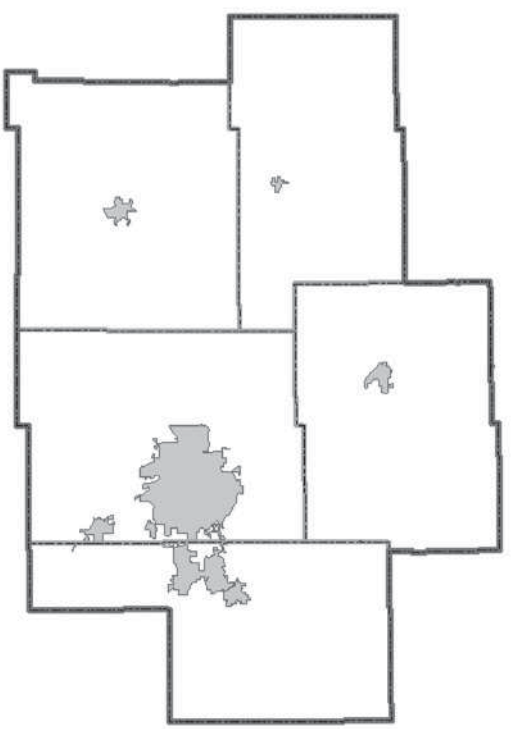
4. Add metro_bndry, metro_uauc00, and metro_cos from the Chapter 2 folder. You can add all three at once by clicking one of the file names and then clicking the others while holding down the Ctrl key on the keyboard. Click the Add button.
5. Ensure that the metro_bndry layer appears first in the list under the Layers data frame, followed by metro_cos and metro_uauc00. If they are not in this order, you can click on a layer name in the Table of Contents and drag the layer to a new position.



6. Click the fill symbol below metro_bndry, and click the Hollow symbol. In the same Symbol Selector dialog box, click Edit Symbol, and then click Outline. Scroll down and select Boundary, State and change the color to blue. To exit, click OK on each dialog box until the Symbol Selector is dismissed. Your metro_bndry should look like the following:

7. Click the fill symbol below metro_cos, and click the Hollow symbol. In the same Symbol Selector dialog box, click Edit Symbol, and then click Outline. Scroll down and select Boundary, County. To exit, click OK on each dialog box until the Symbol Selector is dismissed. Your metro_cos should look like the following:

8. Your map should look like the following:



9. To print the map, first select Layout View under View to compose the map for printing.
10. Click Insert, and insert a title (Springfield, MO, Metropolitan Statistical Area).
11. Click File, and then click Print, or click Export Map if you would like a digital version but change type to a common format like pdf or jpg.
12. Select Data View under View to return to the Data View.
13. To begin a query, click the Selection menu at the top of the ArcMap screen, and choose Select By Attributes. In the dialog box, choose metro_uauc00 as the Layer. Enter the following query, click Apply, and then click Close:

"POP2000">=10000

14. Open the attribute table of metro_uauc00 (right-click the layer name), and note that one of the five urban areas (Springfield, MO,

Urbanized Area) was selected. Thus, under Section 1 of the OMB guidelines, the Springfield, Missouri, MSA qualified initially for consideration based on the fact that it had one qualifying UA. Because the qualifying area was a UA rather than a UC, it would later be identified as an MSA, rather than a micropolitan statistical area. Close the table and keep the selection.

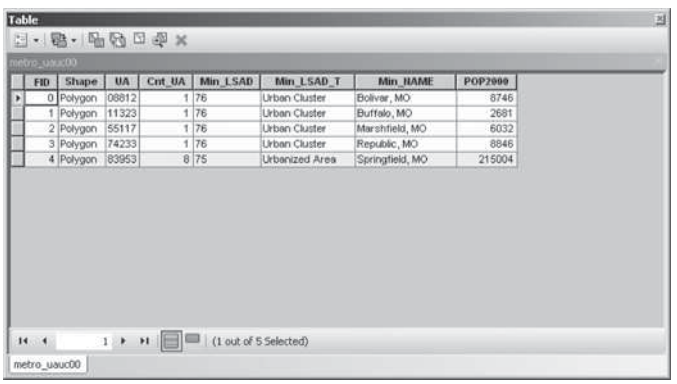
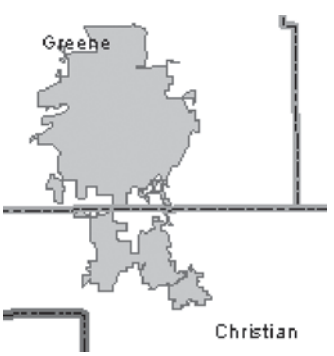


Table
metro_uauc00
FID Shape UA Cnt_UA Min_LSAD Min_LSAD_T Min_NAME POP2000
0 Polygon 08812 1 76 Urban Cluster Bolivar, MO 8746
1 Polygon 11323 1 76 Urban Cluster Buffalo, MO 2681
2 Polygon 55117 1 76 Urban Cluster Marshfield, MO 6032
3 Polygon 74233 1 76 Urban Cluster Republic, MO 8846
4 Polygon 83953 8 75 Urbanized Area Springfield, MO 215004
(1 out of 5 Selected)
metro_uauc00

Central Counties

Refer to page 10 of the metro_micro_procs.pdf document. The central county or counties of a CBSA are those counties that (a) have at least 50 percent of their population in urban areas with a population of at least 10,000 or (b) have within their boundaries a population of at least 5,000 located in a single urban area with a population of at least 10,000.

15. Right-click metro_cos, and click Label Features. Note that Greene and Christian are the only counties that intersect the qualifying urban area. Accordingly, it is necessary to test only these two counties for central county status.

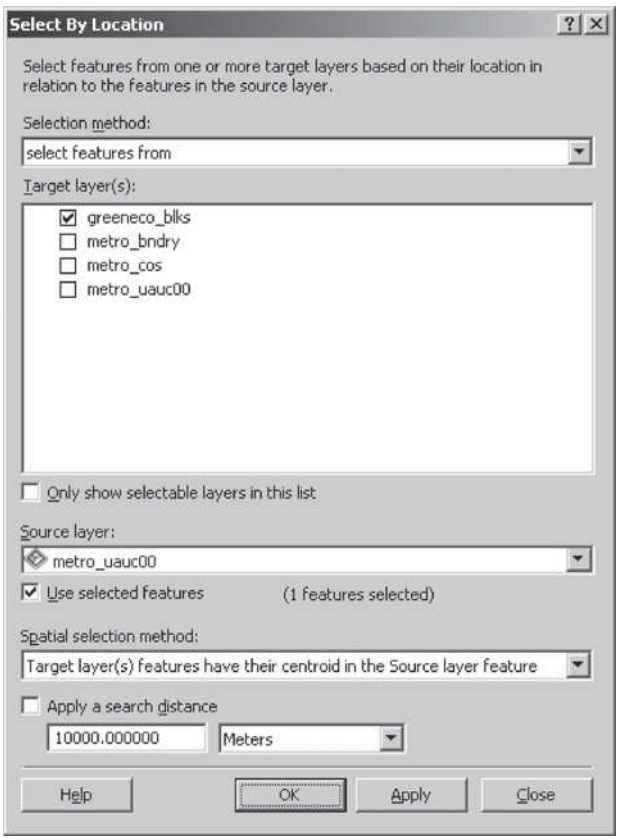


16. Use the Identify tool, and click Greene County. Click the Identify from the dropdown box in the Identify dialog box, and select metro_cos as your layer to identify. Once you have the correct identifying layer, click Greene County again. Note that the 2000 population for Greene County is 240,391.

17. Now click Christian County with the Identify tool, and note that it has a 2000 population of 54,285. Close the Identify dialog box, as you are now ready to determine the percentage of these counties' populations within the Springfield UA. The Springfield UA should still be selected (highlighted in blue).

18. Click Add Data, and add greeneco_blks (these are the census blocks for Greene County that contain population counts).

19. Click the Selection tab at the top of the ArcMap screen, and choose Select By Location. In the dialog box, select greeneco_blks as the Target layer and metro_uauc00 as the Source layer, and make sure that the box is checked for "use selected features." For the spatial selection method, choose "Target layer(s) features have their centroid in the Source layer feature" (see screen shot for correct settings).



20. Click Apply, and then click Close.

21. Right-click the layer name greeneco_blks, and select Open Attribute Table. Scroll over and right-click on the POP2000 field, and click Statistics. Note a population sum of 188,252, which indicates that 78 percent of Greene County's population is within the Springfield UA. Thus, Greene County qualifies as a central county under subsection (a) of Section 2 of the OMB guidelines on central counties. Close Statistics Results, and close the table.

22. Right-click greeneco_blks, and click Remove.

23. Click Add Data, and add chrstnco_blks (these are the census blocks for Christian County that contain population counts).

24. Repeat Steps 19 through 22, replacing greeneco_blks with chrstnco_blks. If you did your work correctly, you should determine a population sum of 26,466 for Christian County, which indicates that 48 percent of Christian County's population is in the Springfield UA. This is short of the 50 percent required to qualify under subsection (a), but because it has more than 5,000 people within a single UA, Christian County qualifies as a central county under subsection (b) of Section 2.

Outlying Counties

Refer to page 10 of the metro_micro_procs.pdf document. A county qualifies as an outlying county of a CBSA if it meets one of the following commuting requirements: (a) At least 25 percent of the employed residents of the county work in the central county or counties of the CBSA, or (b) at least 25 percent of the employment in the county is accounted for by workers who reside in the central county or counties of the CBSA.

25. Click Add Data, and add commute_matrix.dbf.

26. Right-click commute_matrix, and click Open. The table includes fields for where workers live (RESIDENT), where those workers

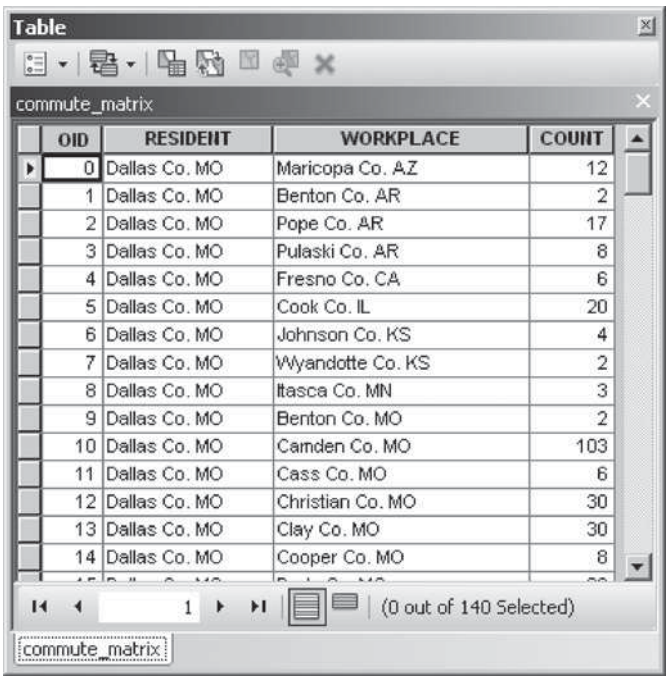


Table
commute_matrix
OID RESIDENT WORKPLACE COUNT
0 Dallas Co. MO Maricopa Co. AZ 12
1 Dallas Co. MO Benton Co. AR 2
2 Dallas Co. MO Pope Co. AR 17
3 Dallas Co. MO Pulaski Co. AR 8
4 Dallas Co. MO Fresno Co. CA 6
5 Dallas Co. MO Cook Co. IL 20
6 Dallas Co. MO Johnson Co. KS 4
7 Dallas Co. MO Wyandotte Co. KS 2
8 Dallas Co. MO Itasca Co. MN 3
9 Dallas Co. MO Benton Co. MO 2
10 Dallas Co. MO Camden Co. MO 103
11 Dallas Co. MO Cass Co. MO 6
12 Dallas Co. MO Christian Co. MO 30
13 Dallas Co. MO Clay Co. MO 30
14 Dallas Co. MO Cooper Co. MO 8
1
(0 out of 140 Selected)
commute_matrix

work (WORKPLACE), and the number of those workers with a residential and workplace match (COUNT).

27. Click the Select by Attributes button.

Reposition the table and the Select by Attributes dialog box so you can see both.

28. Enter the following query, and click Apply:

"RESIDENT"='Dallas Co. MO'

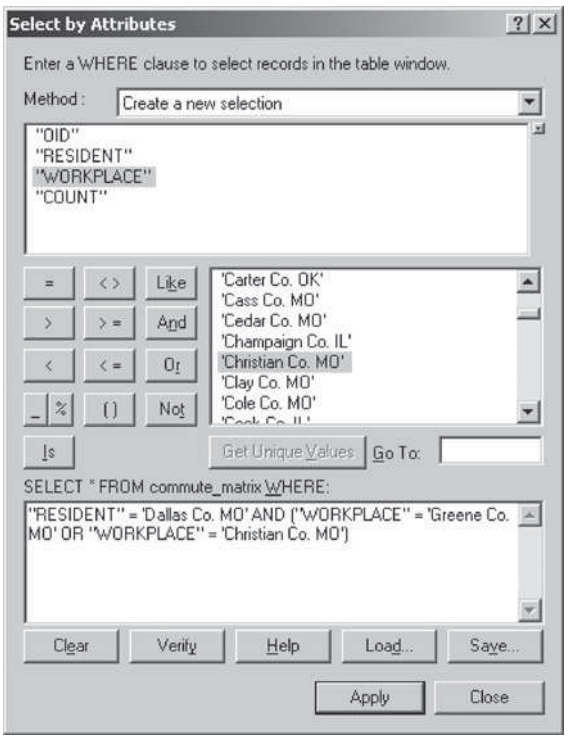
29. In the table, right-click Count, and select Statistics. Note that the Total Resident Workers value for Dallas County is 6,425.

30. Close the Statistics Results box, and change the query to the following:

"RESIDENT"='Dallas Co. MO' AND ("WORKPLACE"= 'Greene Co. MO' OR "WORKPLACE" = 'Christian Co. MO')

Then click Apply.

31. In the table, right-click Count, and select Statistics. Note that the Total Resident Workers for Dallas County commuting to Greene and Christian Counties is 1,876. Given that the total labor force of Dallas County is 6,425, then 29 percent of them are commuting to the central counties of the Springfield MSA. Accordingly, Dallas County qualified as an outlying county of the MSA under subsection (a) of Section 3 of the OMB guidelines.



32. Repeat Steps 28 through 31 for Polk and Webster Counties to determine under which rule they qualified for inclusion as outlying counties in the Springfield MSA. If you do it correctly, you should find that 30 percent of Polk County's workers and 49 percent of Webster County's workers commute to the central counties of Greene and Christian. Thus, all three outlying counties qualify as outlying counties under subsection (a) of Section 3 of the OMB guidelines. As a result, it is not necessary to test the reverse commuting criteria contained within Section 3(b) of the guidelines.

ArcGIS 10 Short Essay: In the United States, MSAs are defined by the strength of journey-to-work flows from outlying counties to central counties or from central counties to outlying counties of the metropolitan area in question. This reflects the motor vehicle way of life in large cities, stemming from the 20th century. However, today cities have more telecommuters (i.e., people who work several days of the week at home and are connected to the main office through the Internet and other technologies). Write an essay addressing the following issue: Do you consider the telecommuting phenomenon important enough today to change the current MSA inclusion rules? If so, suggest how you would change the inclusion rules to reflect aspects other than commuting. If you do not think telecommuting is significant enough to change the inclusion rules then explain. Include a map of the Springfield, Missouri, MSA with your essay.

Log in to www.mygeoscienceplace.com for ArcGIS Exercise data files, Google Earth™ Exercise kmz files, RSS feeds, flashcards, web links, and self-study quizzes to enhance your study of defining the metropolis.

CHAPTER

3 The Internal Structure of Cities

The internal structure of cities approach to urban geography considers the patterns of urban distributions within cities and attempts to understand the processes that cause the differentiation of spatial patterns. The extreme opposite of this approach, covered in the next chapter, is an urban systems approach, which considers the relations of cities to each other and to the areas and hinterlands they serve. Some refer to these two approaches to the study of urban geography as intraurban (within cities) investigations versus interurban (among cities) investigations. Not all urban investigations can be neatly placed into one of these two categories, but the designations serve as a useful pedagogical tool for discussing urban geography research.

Among the questions the internal structure approach seeks to answer are the following: Do rich people and poor people appear to reside within different sections of cities? Do new immigrants congregate in certain sections of the city? Is this also true of individual immigrant groups? How does the distribution of population relate to urban transportation corridors? What is the spatial relationship of city workers to their jobs? Do urban minorities live in closer proximity to environmental hazards than do their nonminority counterparts?

The chapter starts with a review of the classic models of urban internal structure. First is the concentric zone model of urban development, which postulates that cities tend to grow and develop in concentric rings around their downtowns. The Chicago School of sociology advanced the concentric zone model in the 1920s, a time when immigrants had been the critical stimulant for urban growth in Chicago for several decades. As a result, much attention was paid to the effect immigrant assimilation had on the ring pattern. The second model is the sector model, which suggests that urban growth and development occur in wedges emanating out from a city's downtown. This model put much emphasis on high-status households as the principal agents of change as opposed to low-status households. The third model is known as the multiple nuclei model of urban development, which hypothesizes a more complex urban area than the concentric zone model, with multiple centers, rather than just a single dominant center of activity.

These classic models of urban development have persisted in the urban literature, and they continue to influence some modern interpretations of city growth. Nevertheless, the models have come under heavy criticism lately from the Los Angeles (L.A.) and New York Schools of urban studies. The L.A. School claim is that these classic models have had a tight grip on how urban analysis has taken place in the last century and do not capture the evolving realities of a postmodern urbanism. The L.A. School draws on processes and trends seen in the Los Angeles region and offers that region as a model for current and future urbanism. Responses by some Chicago School advocates are reviewed, highlighting the issue as one of the more critical debates within urban studies. The New York School also points out limitations in the Chicago School model, but does not agree that Los Angeles is the principal prototype for current and future urbanism. Rather, its proponents identify several characteristics of New York City's urbanism that are found in other urban centers and advocate that those characteristics should be considered alongside the processes being attributed to Los Angeles urbanism.

A geographic information system (GIS) analysis of Chicago and Los Angeles is presented next. The "Analyzing an Urban Issue" section introduces density gradients as a tool for illustrating intraurban structure, contrasts Mexico City's internal density patterns with those of two American cities, and offers the Latin American city model as an explanation for the differences. A concluding case study of recent growth trends in Chicago shows a city equal in dynamics to that of Los Angeles on several key variables.

3.1 CLASSIC URBAN DEVELOPMENT MODELS

3.1.1 Concentric Zone Model

The *concentric zone model* of urban development is an early depiction of internal urban structure (see Figure 3.1). Ernest Burgess's concentric zone model first appeared in Chapter 2 of Park, Burgess, and McKenzie's (1925) *The City: Suggestions for the Investigation of Human Behavior in the Urban Environment*. The influence of the Chicago School of sociology on the discipline of urban geography, as discussed in Chapter 1, was much broader than the concentric zone model. However, the model had great appeal because of its explicit spatial aspects.

Living and experiencing the tremendous growth of Chicago in the 1920s, Burgess hypothesized that cities grew in concentric rings outward from a *central business district* (CBD). The inner ring consisted of the central business district (CBD), which for Chicago was the Loop, the original name for the elevated tracks that formed a loop in the central area of the city. The CBD was encircled by what Burgess called zones of transition, workingmen's homes, residential, and commuters (see Figure 3.2). The *zone of transition* was a port of entry for poor immigrants who worked in nearby factories and was the most dynamic of all of the rings, as the population was always turning over. The next outer ring, the *zone of workingmen's homes,* consisted primarily of industrial workers who had moved out from the zone of transition. Made up largely of second-generation immigrants, the residents of this ring had accumulated sufficient wealth to purchase their own homes. The fourth ring was referred to as the residential zone, a zone of better residences. In Chicago, the housing in this ring included many bungalows, one-story houses on 30-foot lots, and the three-story apartment buildings, which were more numerous near El lines, for most middle-income Loop workers who were without autos. Finally, there was the commuters' zone, made up of suburban areas or satellite cities within a 30- to 60-minute trip of the CBD.

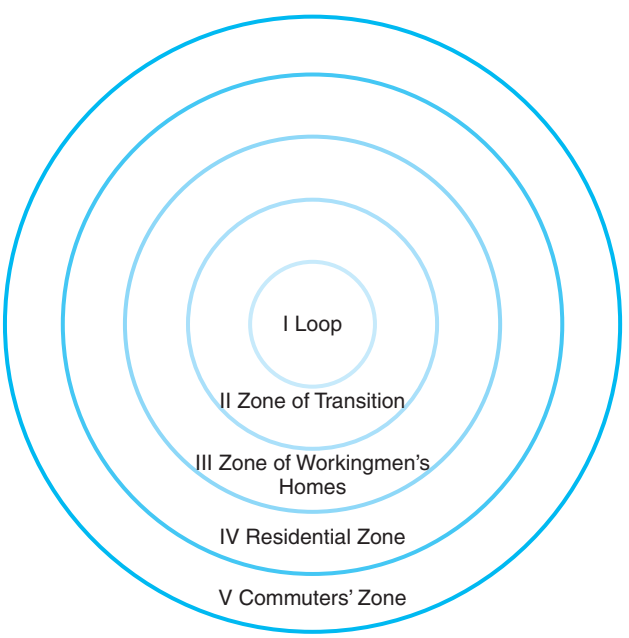


FIGURE 3.1 The concentric zone model of urban development. *Source*: Burgess, Ernest. 1925. "The Growth of the City," in R.E. Park, E.W. Burgess, and R.D. McKenzie, THE CITY, University of Chicago Press. © 1925, 1967 by The University of Chicago. All rights reserved. Reprinted by permission. Chart 1. P. 51. "The growth of the city."

FIGURE 3.2 Modern-day view of Chicago's zone of transition.

The concentric zone concept was both spatial and temporal. The rings would continue to expand through time because there were always new immigrants replacing the residential vacancies created by those exiting the zone of transition. As time passed, the entire structure expanded, and each ring grew at the expense of the one farther out. Burgess argued that these changes came because of the general invasion and succession processes espoused by the Chicago School.

3.1.2 Sector Model

Hoyt's (1939) *sector model* was a second contribution to our understanding of the spatial aspects of city growth (see Figure 3.3). Hoyt proposed the sector model in *The Structure and Growth of Residential Neighborhoods in American Cities,* prepared for the Federal Housing Administration. In that study, the purpose of which was to classify neighborhoods according to their mortgage-lending risk, Hoyt examined 142 American cities. Like Burgess, Hoyt recognized that cities developed a center characterized by business and service activities, but Hoyt's model suggested that residential growth extended outward from the center in wedges or sectors, rather than concentric rings. Urban residential growth was therefore seen as axial, associated with streetcar lines and other major transportation radials (see Figure 3.4).

Hoyt believed that high-income households were the engines of growth in that they preempted the most desirable land in the emerging city, mostly well away from industrial activity and often in the direction of natural amenities. Thus, in the sector model, high-rent areas take the form of wedges along axial corridors away from the center. The medium-rent areas occupy land adjacent to and on either side of the high-rent households, whereas low-rent wedges protrude in opposite directions from the high-rent sectors, often alongside industrial areas. The notion that high-income households played the most important role in the spatial growth of cities was in stark

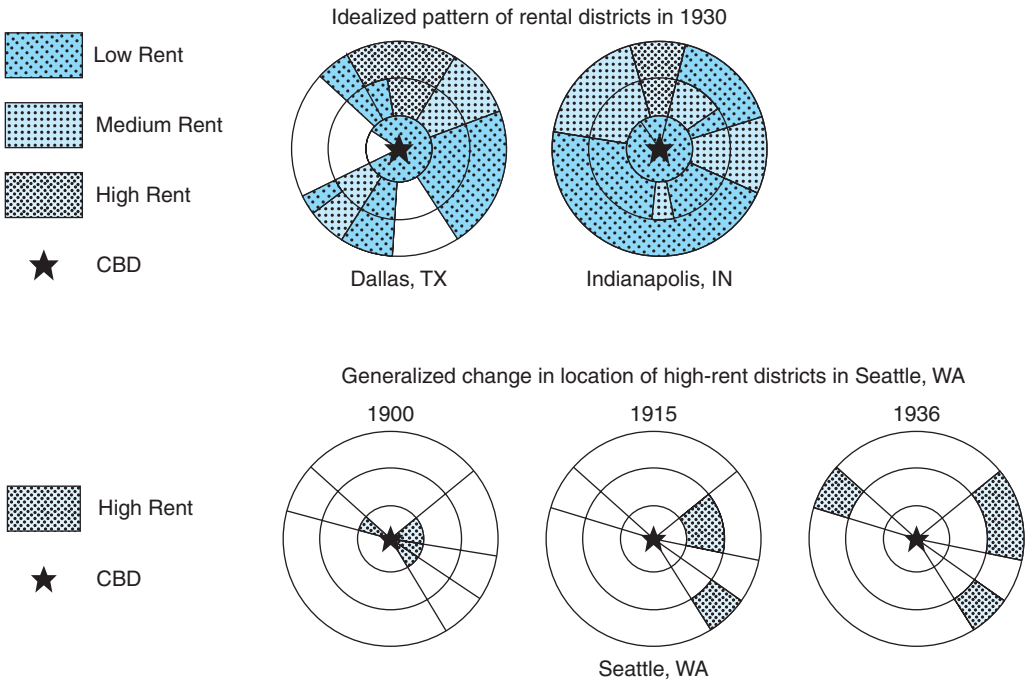


FIGURE 3.3 The sector model of urban development. *Source*: Hoyt, H. (1939). *The Structure and Growth of Residential Neighborhoods in American Cities*. Washington, DC: Federal Housing Administration.

contrast to Burgess's emphasis on the invasion and succession of lower-status households within the zone of transition as the driving force for growth and change.

The conclusions of Hoyt's study are summarized here:

1. The high-rent (or high-price) area is located in one or more specific sectors on one side of the city. These high-rent areas are generally peripheral locations, although some high-rent sectors extend continuously from the center of the city.

2. High-rent areas often take the form of wedges, extending in certain sectors along radial lines outward from the center to the periphery of the city.

3. Medium-rent areas tend to be located on either side of the high-rent areas.

4. Some cities contain large areas of medium-rent units, which tend to be found on the peripheries of low- and high-rent areas.

5. All cities have low-rent areas, frequently found opposite high-rent areas and usually in the more central locations.

Some interpretations of modern urban landscapes continue to draw linkages to the findings of Hoyt. For instance, Adams (1991) noted persistence in the sector patterns by reviewing a less-well-known follow-up investigation by Hoyt himself with 1960 census data. Adams (1991) extended the record of observation with his own analyses of 1970 and 1980 census data for 20 metropolitan areas. For the Twin Cities, Adams (1991) argued that builders initiate sector development by concentrating new construction on the suburban edge and setting in motion vacancy chains. A vacancy chain occurs when households move to a new address and leave behind vacancies. Adams demonstrated that the vacancy chains behaved in sectors, at least in the Minneapolis housing market (see Figure 3.5). One sector in particular, Sector B, saw its relative market value of neighborhoods drop as high-priced new housing was built on the suburban edge. The box inset in the figure shows the decline in housing price rank of neighborhoods in Sector B for 1980, compared to 1970. The assumption is that many household moves occurring within sectors originate closer to the city center and have destinations on the outer edge, often on the same transport corridor. Such moves in the aggregate might account for the overall decline in the market values in the inner neighborhoods of the sector as wealth is transferred along with the moves to the outer suburbs. Gentrification of the inner part of the sector can offset these declining market values, a topic discussed in detail in Chapter 5.

FIGURE 3.4 Streetcar sector in Toronto.

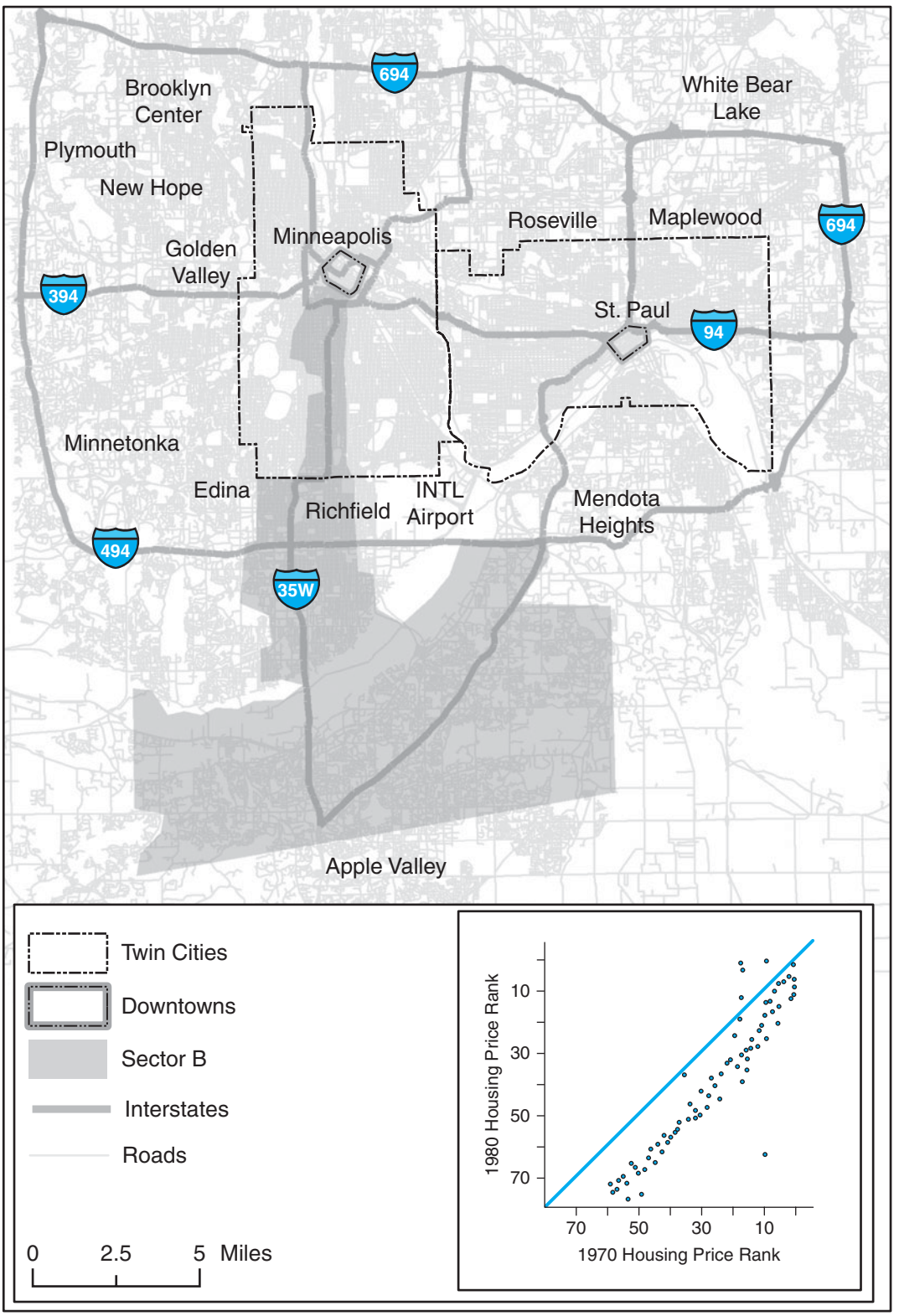


FIGURE 3.5 Changes in housing price ranks, 1970 to 1980, for housing Sector B in Minneapolis–St. Paul. *Source*: Adams, J. S. (1991). "Housing submarkets in an American metropolis." In *Our Changing Cities,* edited by J. F. Hart, pp. 108–126. Baltimore, MD: Johns Hopkins Press. Figure 7.3, "Changes in tract ranks in housing submarkets," p. 118.

The persistence of sectors in everyday behavior is further demonstrated for Chicago, where communities with the highest percentage of workers using public transportation in 2000 showed a strong orientation to commuter rail lines (see Figure 3.6). Living close to commuter rail lines, particularly train stations, is one of the best predictors of the use of these lines. The attraction of such access accounts for higher density and higher land values following these transit lines, which all reinforce the sector pattern of urban development that Hoyt had identified in his model. "Kiss and ride" parking lots are often placed close to these train stations, resulting in even greater sector flows during peak commuting times.

3.1.3 Multiple Nuclei Model

In contrast to Burgess and Hoyt, who both emphasized growth and development away from a single CBD, Harris and Ullman (1959) developed the multiple nuclei model of urban development, arguing that growth and development occur around multiple centers of economic activity in a metropolitan area (see Figure 3.7). For instance, not only does this hypothetical metropolis have a CBD, but also it has a wholesale light manufacturing center, a heavy manufacturing center, an outlying business center, and an industrial suburb. Some of these outlying industrial and business centers are quite compact and look like a downtown, such as Burbank in the Los

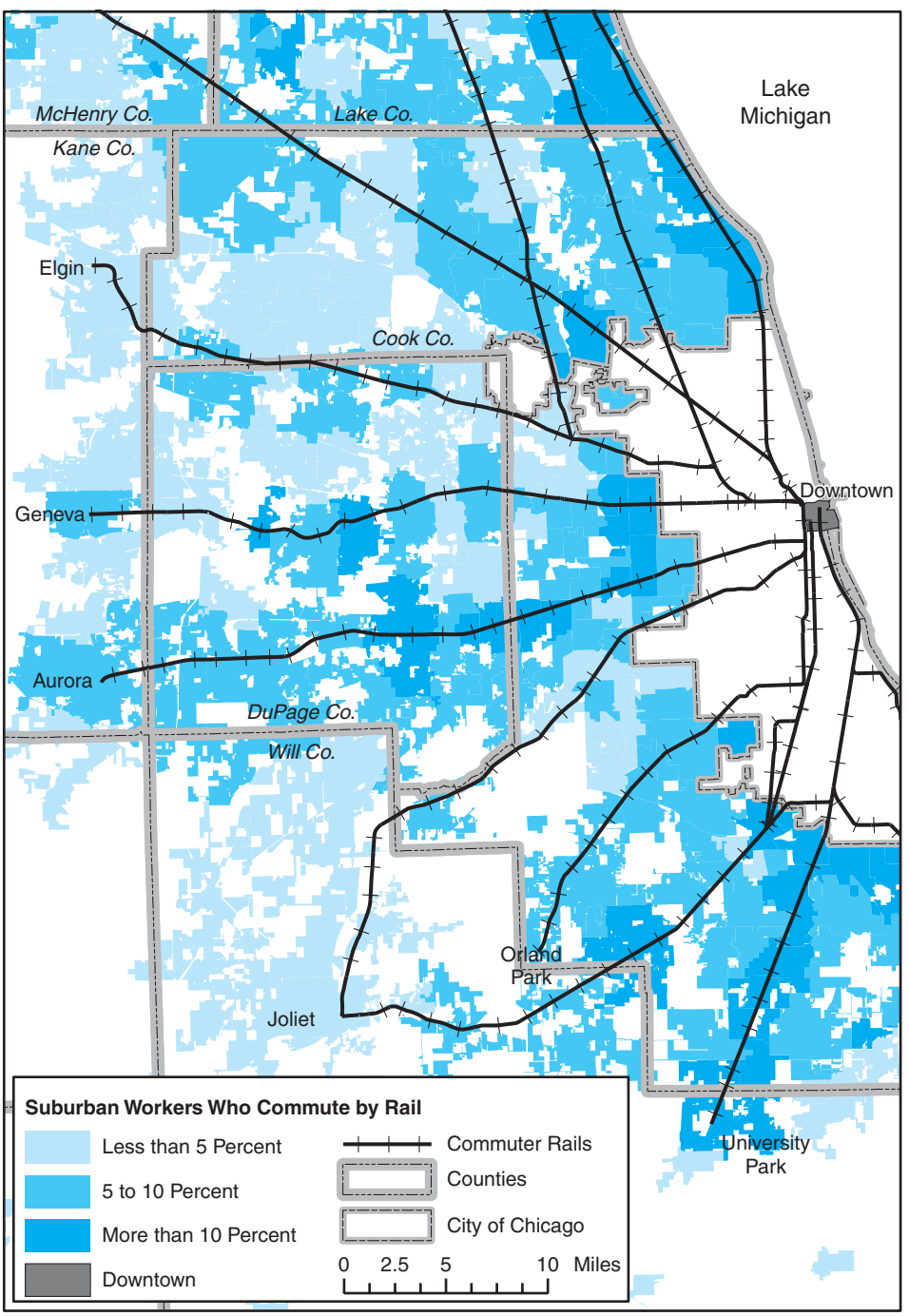


FIGURE 3.6 Chicago sectors revealed by suburban rail commuter preferences.

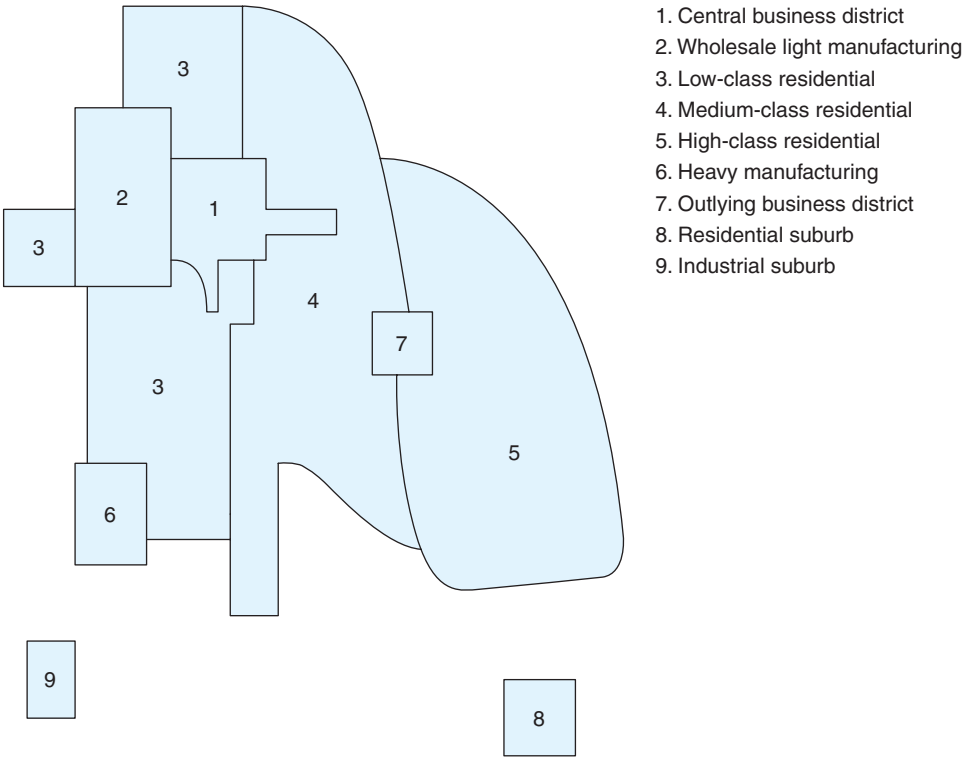


FIGURE 3.7 The multiple nuclei model of urban development. *Source*: Harris, D.D. and Ullman, E.L. 1959. "The Nature of Cities," in Mayer, H.M., and Kohn, C.F., READINGS IN URBAN GEOGRAPHY, University of Chicago Press. Reprinted by permission of University of Chicago Press. Figure 5. P. 281. "Generalization of Internal Structure of Cities."

Angeles area. Wholesale and light manufacturing centers, on the other hand, are spread over a wider territory as illustrated by Seattle, Washington's wholesale district (see Figure 3.8).

With respect to the origins of the various nuclei, the model recognized differences across cities:

> In some cities these nuclei have existed from the very origin of the city; in others they have developed as the growth of the city stimulated migration and specialization. An example of the first type is Metropolitan London, in which "The City" and Westminster originated as separate points separated by open country, one as the center of finance and commerce, the other as the center of political life. An example of the second type is Chicago, in which heavy industry, at first localized along the Chicago River in the heart of the city, migrated to the Calumet District, where it acted as a nucleus for extensive new urban development. (Harris & Ullman, 1959, p. 283)

This passage points out that a number of major world cities developed around more than one early center, most of which absorbed existing villages; the irregular street plans of these absorbed areas often can still be discerned within the larger city, as is the case with Greenwich Village in New York City and Roxbury and Cambridge in Greater Boston (Forstall, 2010). Cities will have a dominant nucleus, typically around the initial point of settlement near a landing place or waterfront in many American cities. Harris and Ullman (1959) attributed the rise of separate nuclei to a combination of four factors:

1. Certain activities require specialized facilities. The retail district, for example, is attached to the point of greatest intracity accessibility, the port district to suitable waterfront, the manufacturing districts to large blocks of land and to water or rail connections, and so on.
2. Certain like activities group together because they profit from cohesion. Retail districts benefit from grouping, which increases the concentration of potential customers and makes possible comparison shopping. Financial and office-building districts depend on facility of communication among offices within the district. The Merchandise Mart of Chicago is an example of wholesale clustering.
3. Certain unlike activities are detrimental to each other. The antagonism between factory development and high-class residential development is well known. The heavy concentrations of pedestrians, automobiles, and streetcars in the retail district are antagonistic both to the railroad facilities and the street loading required in the wholesale district and to the rail facilities and space needed by large industrial districts—and vice versa.
4. Certain activities are unable to afford the high rents of the most desirable sites. This factor works in conjunction with the foregoing. For example, bulk wholesaling and storage activities that require much room and low-class housing are unable to afford the luxury of high land with a view (Harris & Ullman, 1959, pp. 283–284).

FIGURE 3.8 Wholesale and light manufacturing district in Seattle.

These combinations of forces have brought about the development of separate nuclei within cities, with the number of nuclei that develop varying mainly with the size of the city.

In addition to establishing the existence of multiple nuclei, Harris and Ullman (1959) identified four urban components or districts that have developed in virtually all large American urban areas. The first and most dominant is the *CBD,* which Harris and Ullman reminded us is not necessarily at the city's geographic center and might even be near one edge if the city is on the sea or a lake. The CBD is the focus of intracity transportation facilities, making it the single most convenient location to access from anywhere in the urban area.

The *wholesale and light manufacturing district* is usually adjacent to, but not surrounding, the CBD and is accessible to railroads and trucks. This district's activity is primarily manufacturing, and its location takes advantage of both transport facilities and access to the urban area's labor.

Next the *heavy industrial district* is on the edge of the city, where it can occupy large tracts of bad space with good transport. Although once on the edge of the city, this district appears relatively close in as the urban area has expanded. Chicago offers good examples of such districts:

> In Chicago about a hundred industries are in a belt three miles long, adjacent to the Clearing freight yards on the southwestern edge of the city. . . . The stockyards of Chicago, in spite of their odors and size, have been engulfed by urban growth and are now far from the edge of the city. They form a nucleus of heavy industry within the city but not near the center, which has blighted the adjacent residential area, the "Back-of-the-Yards" district. (Harris & Ullman, 1959, p. 285)

Fourth is the *residential district,* differentiated into high-class, middle-class, and low-class segments. The high-class segments are typically on high, well-drained land and away from air and noise pollution, whereas the low-class segments are situated close to factories and other nuisances. Other minor nuclei were recognized by Harris and Ullman, including cultural centers and parks. Finally, residential and industrial suburbs were distinguished from satellites that were separated from the central city by large distances, with little daily commuting to or from that center. At the time that Harris and Ullman devised the model, Gary was considered an industrial suburb, whereas Elgin and Joliet were considered industrial satellites.

3.2 STRUCTURALISM AND POSTMODERNISM: ALTERNATIVE PERSPECTIVES

The classic models of urban development were developed early in the 1920s and through the 1950s. As a consequence, a number of researchers have dismissed them for lack of power in explaining contemporary urban change. Beginning in the 1970s, Harvey (1973) offered an alternative perspective that applied Marxian economics to the study of conditions in the city. The

approach, which became known as the structural approach, emphasized analyses of uneven development and the role of capitalists in fostering and widening it. Gottdiener (1994) reviewed how Harvey was influenced by the ideas of French philosopher Henri Lefebvre, who is credited with reviving the Marxist tradition in social science in the 1970s. Lefebvre posited two circuits of capital, the first circuit relating to industrial activity and the second to real estate activity. The circuits concept was particularly appealing to Harvey:

> Harvey argued that capitalists involved in the first industrial circuit are principally interested in location within the urban environment and in reducing their costs of manufacturing. Capitalists in the second circuit hold a different set of priorities relating to the flow of investment and the realization of interest on money loaned or rent on property owned. (Gottdiener, 1994, pp. 134–135)

The result of these differences in how capital is invested and reinvested in these circuits is uneven development—for instance, a heavy investment in real estate in the suburbs at the expense of abandoned neighborhoods in the central city.

A more recent extension to the Marxist urban geography approach is that advanced by the postmodernists. In rejecting modernist urban theory, which would include the classic urban models, the postmodernists cannot be pigeonholed; rather, they represent varying views of the city:

> [T]here are at least two camps: neo-Marxian urbanists, such as Fredrick Jameson and David Harvey, who have proclaimed the arrival of a "condition of postmodernity," and more self-conscious postmodernists, such as Jean Baudrillard, Michael Dear, and Edward Soja (in his later work), who claim that the radical critique of modernism carried out by such theorists as Jacques Derrida and Jean-Francois Lyotard should guide a post-Marxian epistemology for interpreting the postmodern condition. (Ethington and Meeker, 2002, p. 414)

3.3 HAVE THE CLASSIC MODELS STOOD THE TEST OF TIME?

In conclusion, a number of spatial models of urban development have been proposed for understanding how urban areas grow and develop. At the same time, alternative perspectives have arisen as a result of changing times and urban processes. Mapping the census year when Chicago census tracts first reached 2,000 persons per square mile shows that the region exhibits spatial elements of all three of the classic models (see Figure 3.9). The 1950 high-density tracts form a pattern in between a ring and sectors. However, the 1960 high-density tracts show that sector development patterns were well in place at that time. Also, outlying industrial suburbs can be discerned from the 1950 and 1960 density patterns. The sector

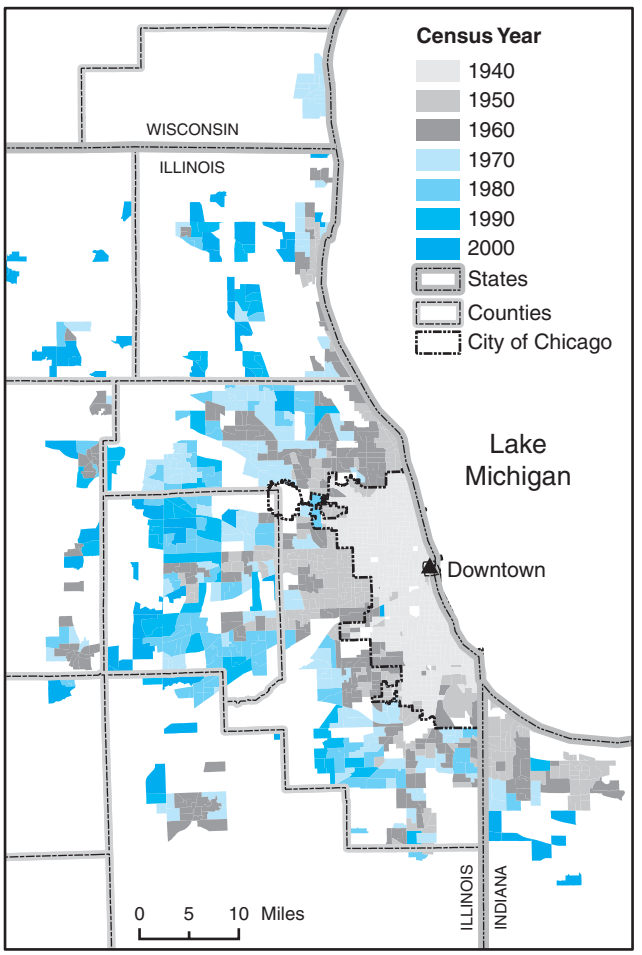


FIGURE 3.9 The year that Chicago metropolitan area census tracts first reached 2,000 persons per square mile, 1940 to 2000.

pattern was reinforced by the development trends of the 1970s and 1980s as density increased along former sectors. The 1990s also saw a continuation of growth along these same sectors, although multiple nuclei were evident in the concentration of new high-density areas around traditional outlying centers, as well as in the newly emerging edge cities.

However, could imposing such old models on the urban landscape limit our understanding of current-day urban patterns and processes? Some urban scholars continue to make note of the pattern and legacies, especially for Chicago:

> Located on an essentially featureless plain at the shore of Lake Michigan, Chicago has a physical organization that is stunningly simple. The symmetrical semicircular core expands almost monotonically into the featureless plain from along the lakeshore, a pattern distorted only modestly by the sectoral divisions formed by radial rivers and rail lines. Beyond Cook County are its five collar counties, which contain the overflow in independent suburbs and satellite towns. (Abu-Lughod, 1999, pp. 21–22)

Berry and Kasarda (1977) showed, that in spite of debate about the relative merits of the concentric zone and sector

models, there was substantial evidence to support the existence of both:

> A succession of large-scale factor analytic studies conducted since the end of the Second World War now makes it possible to state definitively that the three models are additive contributors to the total socioeconomic structuring of city neighborhoods. In each of the studies the answer is the same: there are three dominant dimensions of variation. These are (1) the axial variation of neighborhoods by socioeconomic rank; (2) the concentric variation of neighborhoods according to family structure; and (3) the localized segregation of particular ethnic groups. (p. 89)

Nevertheless, these models have come under intense scrutiny, especially recently by the new postmodernist L.A. School:

> Much of the urban research agenda of the 20th century has been predicated on the precepts of the concentric zone, sector, and multiple-nuclei theories of urban structure. The influences can be seen directly in factorial ecologies of intra-urban structure, land-rent models, studies of urban economies and diseconomies of scale, and designs of ideal cities and neighborhoods. The specific and persistent popularity of the Chicago concentric ring model is harder to explain, however, given the proliferation of evidence in support of alternative theories. The most likely reasons for its endurance (as I have mentioned) are related to its beguiling simplicity and the enormous volume of publications produced by adherents of the Chicago School. (Dear, 2002, p. 16)

In the first issue of *City & Community,* Dear (2002) summarized the major points of the L.A. School's doctrine and invited a debate on the topic among contemporaries of the Chicago School of sociology. Dear (2002) summarized the major differences between the L.A. School and traditional Chicago School as follows:

1. Traditional concepts of urban form imagine the city organized around a central core; in a revised theory, the urban peripheries are organizing what remains of the center.
2. A global, corporate-dominated connectivity is balancing, even offsetting, individual-centered agency in urban processes.
3. A linear evolutionist urban paradigm has been usurped by a nonlinear, chaotic process that includes pathologic forms such as transnational criminal organizations, common-interest developments (CIDs), and life-threatening environmental degradation (e.g., global warming). (p. 24)

Dear offered an alternative diagram to that of Burgess, which he considered to capture the spatial manifestations of these assumptions (see Figure 3.10). Note that the diagram is not spatially referenced because in the words of Dear (2002):

> Urbanization is occurring on a quasi-random field of opportunities, in which each space is (in principle) equally available through its connection with the information superhighway. Capital touches down as if by chance on a parcel of land, ignoring the opportunities on intervening lots, thus sparking the development process. The relationship between development of one parcel and non-development of another is a disjointed, seemingly unrelated affair. While not truly a random process, it is evident that the

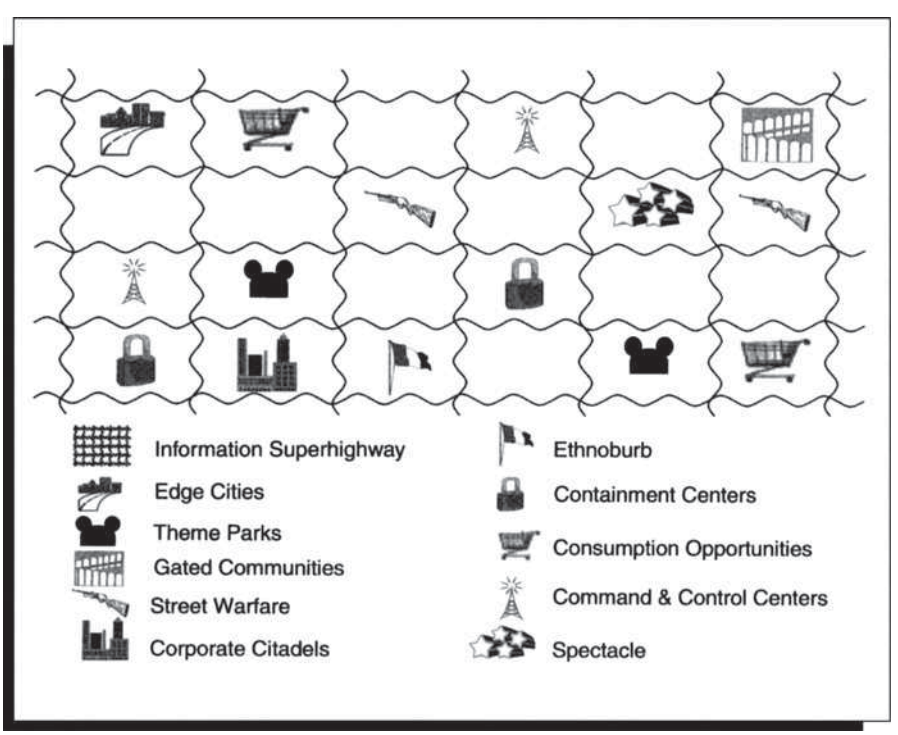


FIGURE 3.10 Dear and Flusty's L.A. School "gaming board" diagram. *Source*: Dear, Michael and Steven Flusty. 2002. "Los Angeles as Postmodern Urbanism," in Michael J. Dear (ed.), from CHICAGO TO L.A.: MAKING SENSE OF URBAN THEORY. Copyright 2002 by SAGE PUBLICATIONS INC BOOKS. Reproduced with permission of SAGE PUBLICATIONS INC BOOKS via Copyright Clearance Center. Figure 3.4. P. 80. "Keno capitalism: a model of postmodern urban structure."

> traditional, center-driven agglomeration economies that have guided urban development in the past no longer generally apply. Conventional city form, Chicago Style, is sacrificed in favor of a non-contiguous collage of parcelized, consumption-oriented landscapes devoid of conventional centers yet wired into electronic propinquity and nominally unified by the mythologies of the (dis)information superhighway. Los Angeles may be a mature form of this postmodern metropolis; Las Vegas comes to mind as a youthful example. The consequent urban aggregate is characterized by acute fragmentation and specialization—a partitioned gaming board subject to perverse laws and peculiarly discrete, disjointed urban outcomes. Given the pervasive presence of crime, corruption, and violence in the global city (not to mention geopolitical transitions, as nation-states give way to micro-nationalisms and transnational criminal organizations), the city as gaming board seems an especially appropriate 21st-century successor to the concentrically ringed city of the early 20th. (pp. 24–25)

Thus, the diagram offered up by the L.A. School contrasts sharply with the concentric zone, sector, and multiple nuclei models, principally with respect to the spatial relationships of the urban components. That is, the L.A. School's diagram as represented by Dear appears as nonspatial or as a "gaming board" because of the apparent chaos in Los Angeles development, as cited in the preceding passage.

Dear's (2002) essay was a call for debate and a debate is what he got. The following are several excerpts from articles submitted by some Chicago School contemporaries that appeared in the same issue of *City & Community*. Abbott (2002) suggested that the processes being identified by Dear as new in Los Angeles were previously considered by the Chicago School:

> More generally, the Chicago view of the city as a mass of interwoven processes and peoples, a complex ecology of groups and spaces, continually under renegotiation, is precisely the processual vision that Dear thinks so revolutionary in the Los Angeles School. He has mistaken Burgess's little diagram for the whole of an enterprise of which he and his colleagues are, like the rest of us, lucky legatees. (p. 34)

Molotch (2002) also suggested that the L.A. School is identifying nothing new, but he further stated that its members are mistaken in attributing what is happening in Los Angeles to local processes, rather than national processes:

> The Chicago scholars were, of course, products of their day, excited by the prospect of a science of society and immersed in the unprecedented scale of urban growth surrounding their campus. They took as general what was specific to their time and place, including its topical agenda. I think Dear and some of his colleagues err in the opposite direction, treating some of what they see in L.A. as more local than it really is. What they take to be a harbinger of the future from Southern California reflects national (at least) dynamics, rather long in evidence. (p. 40)

Sampson (2002) saw Dear's L.A. School proposition as nothing more than a disguise for advancing postmodernism:

> My assessment is ultimately optimistic—a new generation of original research is being carried out unencumbered by the theoretical baggage evident in the new L.A. and the old Chicago. The L.A. baggage, of course, is the revealed "a priori" commitment of the Los Angeles School to advance postmodern theory. (p. 45)

Sampson (2002) also suggested that the L.A. School might be misrepresenting both Los Angeles and Chicago—that is, that patterns and processes identified as unique to Los Angeles are actually found in Chicago:

> Consider Latino immigration and the Pacific Rim emphasis said to characterize modern L.A. Metropolitan Chicago now has 1.5 million residents of Latino or Hispanic origin, by some estimates the second largest concentration in the country. The city proper grew during the 1990s and is one of the most ethnically diverse cities in the United States. (p. 46)

Sassen (2002) agreed with Sampson's point on similarities between Chicago and Los Angeles on such patterns as segregation, concentration effects, inequality, and the distribution of crime. As for the processes Dear (2002) described as unique to Los Angeles, Sassen (2002) claimed they might be mere spatial outcomes to quite similar processes:

> The underlying dynamics may be similar even as their spatial outcomes diverge sharply. Differences in spatial outcomes in this case result from the presence or absence of particular kinds of inherited built environments and metropolitan administrative structure. Being older, much of New York and Chicago's built environment responds to earlier locational logics and their distinct construction and transport options. In the case of Los Angeles, we see the opposite effect: far fewer constraints. But what is feeding spatial outcomes may well be similar. (p. 49)

Sampson (2002) defended a more contemporary Chicago School by amplifying Coleman's (1994) earlier articulation. In the words of Sampson, the school is especially concerned with:

1. A relentless focus on context (especially place).
2. A focus on properties of communities and cities as social systems.
3. A relational concern with variability in forms of social organization as opposed to population attributes (or composition).

4. Continual attention to neighborhood change and spatial dynamics (time and space).
5. An eclectic style of data collection that relies on multiple methods but always connects to some form of observation.
6. A concern for public affairs and the improvement of community life.
7. An integrating theme of theoretically interpretive empirical research. (p. 46)

The debate over whether the collection of Los Angeles urban scholars and their collective viewpoints signifies a new school of urban studies will no doubt continue. One recent paper identified a Chicago School II (school of quantitative urban geography), which the authors argued has remained resilient to the critiques by the postmodernists (Shearmur & Charron, 2004). Nijman (2000) made the case that "many cities in the U.S. are likely to be affected fundamentally by trends that are found in extreme form in present-day Miami" (p. 144). He proposed the concept of the paradigmatic city as one that best captures the most typical trends and features of an urban system.

More recently, Halle (2003) proposed an alternative New York School of urban studies. Halle did not take issue with the L.A. School; rather, he suggested that the urban character (a dispersed and centerless urban area) ascribed by L.A. School proponents to the Los Angeles area does not capture urban settlements with strong centers such as New York City. Unlike the intellectual divide between the postmodern and urban ecology perspectives that was used as the basis for the establishment of an L.A. School, Halle turned to differences in urban structure as the bases of the argument for a New York School.

In contrast to the L.A. School's emphasis on low-density sprawling urban development, Halle suggested that the New York School is characterized by an interest in the central city. Like the L.A. School, the New York School has many voices, including William Whyte (1956), Jane Jacobs (1961), Sharon Zukin (1982), Kenneth Jackson (1985), Richard Sennett (1990), and Robert Stern (Stern, Mellins, & Fisman, 1997). These authors have in common "a fascination with contemporary New York City, especially Manhattan, and a belief, in some cases passionate, in the superiority of city life over suburban life" (Halle, 2003, p. 15). In contrasting the New York School with the Chicago School, Halle (2003) noted that the Chicago School did not depict the central city as desirable for the middle class or the rich, whereas the New York School sees central New York City "as a place for the middle class and the rich, not just the poor and the working class" (p. 15). Halle credited Jacobs as the founding voice for the New York School due to her role in high-profile events such as the defeat of the Lower Manhattan Expressway in the 1960s, as well as her seminal book *The Death and Life of Great American Cities* (1961). Other major contributions to the development of a unique New York School include Zukin's (1982) study of loft living in SoHo, one of the earliest accounts of urban gentrification. Furthermore, Jackson's (1985) *Crabgrass Frontier* and Whyte's (1956) *The Organization Man* are books that Halle included as essential voices for the New York School, as they provide some of the best critique of suburban living.

To illustrate the difference between the two schools, Szanto (2003) contrasted the visual art worlds of New York and Los Angeles. New York, he argued, had the edge early on due to its connections to Europe and an elite willing to spend large sums of money on art. By the 1960s, the visual arts in Los Angeles were taking off, but remained in the shadows of New York. This was due in part to geography; that is, just like urban development in Los Angeles, the visual arts there sprawled as the city expanded. Meanwhile, the density found in New York's art communities provided energy to its participants. The diffuse pattern in Los Angeles, on the other hand, made it difficult for the artists to interact.

A special session on the Chicago and L.A. Schools was organized for the Association of American Geographers 2006 Annual Meeting, which was held in Chicago that year. Dear, representing the L.A. School, and several Chicago School enthusiasts were invited to address three questions:

> To what extent has the "Chicago School" of urban studies, however defined and recognized today, been superseded in contemporary relevance by an "L.A. School," and does the notion of "schools" even possess any particular value today, given the diversity of work in these two places? To what extent has Chicago perhaps yielded paradigmatic status to Los Angeles as a symbol of and research attraction for exposing modern, or rather postmodern, trends in urban spatial organization and process? And to what extent should the singularity of place intrude upon the search for universals in urban processes, and to what degree is that search confounded by, and limited by, the special circumstances of each individual geographic context? (Conzen & Greene, 2008, p. 98)

The answers built on the previous responses published elsewhere and all presentations were later published in a special issue of *Urban Geography* (Conzen & Greene, 2008). The session did not resolve major differences among the various factions, but it did bring into better focus the key differences.

In the next section, we apply GIS technology to map historic urban development patterns in Chicago and Los Angeles. These GIS maps allow for comparisons to be made between the two cities at the center of the first debate, Chicago and Los Angeles, and might provide insight into the similarities and differences between the two with respect to the spatial pattern of development.

3.4 CHICAGO AND LOS ANGELES DEVELOPMENT PATTERNS

A GIS analysis of Chicago and Los Angeles using census tract population data for the period from 1960 to 2000 identifies patterns of concentric circles, sectors, multiple nuclei, and edge city development for both urban places. The growth and development of these places during this period show the importance of transportation technology to sector-oriented growth (Piet & Greene, 2000). The importance of this period is that there was a rapid expansion of urbanized areas, as well as a shift in the major mode of urban transportation away from mass transit to

automobiles. The percentage of the population living within an easily accessible distance of the major transportation corridors is compared for each census period. Because census tract boundaries changed over time, a GIS methodology was developed to proportionately relate earlier census population figures to current census tract boundaries (Figure 3.11). This was accomplished by using the tract comparability tables that the U.S. Census Bureau provides for each census to construct a spreadsheet that relates the current tracts to their parent tracts. Where possible, the relationships were traced back to the 1940 Census. Alternative methods exist for allocating population based on census tract boundary changes over time (Howenstine, 1993). In addition, the National Historical Geographic Information System (NHGIS) provides, free of charge, historic census tract boundary files and attributes on its website (http://www.nhgis.org).

Utilizing the comparability tables, the spreadsheet was built backward to incorporate the 1990 Census. Where there was a one-to-one relationship between the tracts for the two censuses, the corresponding 1990 tract number was entered for each 2000 tract. Where a 2000 tract consisted of parts of multiple 1990 tracts, additional rows were added to the spreadsheet to allow the relationship to be expressed. This process was repeated for each census in the study period, ultimately resulting in a spreadsheet that contained more than 3,000 rows for Chicago and more than 5,000 rows for Los Angeles.

Table 3.1 illustrates how the method was employed for one tract within the city of Chicago. The area encompassed by current Census Tract 1005 has been included within a number of different tracts over time. This resulted in the current tract appearing 10 times in the spreadsheet. Once the spreadsheet was filled in, the population allocated to the current tract was calculated for each census. First, the frequency of each tract was determined for each census. The tract population was then divided by the number of these occurrences, giving a share of the population to each occurrence. Finally, the shares were summed for each 2000 tract. In the example of Census Tract 1005 illustrated in Table 3.1, the 10 entries for the 1960 Census contained

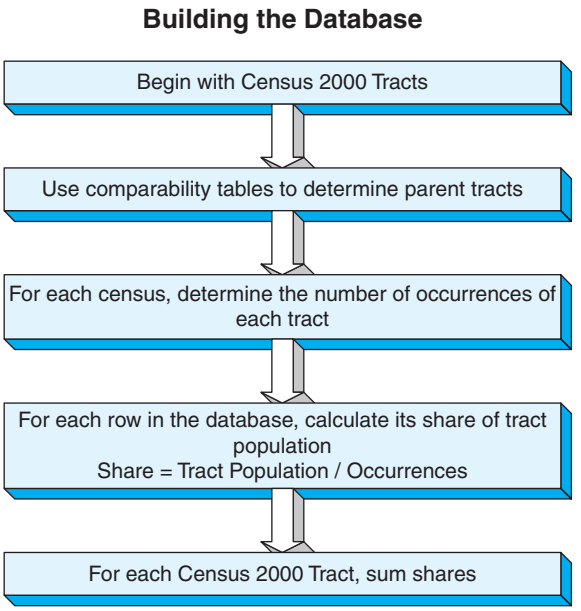

Building the Database
Begin with Census 2000 Tracts
Use comparability tables to determine parent tracts
For each census, determine the number of occurrences of each tract
For each row in the database, calculate its share of tract population
Share = Tract Population / Occurrences
For each Census 2000 Tract, sum shares

FIGURE 3.11 Census tract comparability procedures. *Source*: Piet, P., and Greene, R. P. (2000). "Population growth and the transportation link: Large city comparisons between the humid east and arid west." *Forum of the Association of Arid Lands Studies* 16:45–52.

TABLE 3.1 Comparability Tables and Spreadsheet Entries for Chicago Census Tract 1005

2000–1990	1990–1980	1980–1970	1970–1960	1960–1950	1950–1940
1005 ⇒ 1005	1005 ⇒ 1005	1005 ⇒ 1005 7603(pt)	1005 ⇒ 142-Z(pt) NPT-85(pt) 7603 ⇒ 142-Z(pt) NPT-85(pt)	142-Z ⇒ 142 141(pt) 143(pt) CC-6(pt) NPT-85 ⇒ CC-6(pt)	141 ⇒ 141 142 ⇒ 142 143 ⇒ 143 CC-6 ⇒ Not tracted

	Year						
	2000	1990	1980	1970	1960	1950	1940
Tract ID	1005	1005	1005	1005	142-Z	141	141
	1005	1005	1005	1005	142-Z	142	142
	1005	1005	1005	1005	142-Z	143	143
	1005	1005	1005	1005	142-Z	CC-6	—
	1005	1005	1005	1005	NPT-85	CC-6	—
	1005	1005	1005	7603	142-Z	141	141
	1005	1005	1005	7603	142-Z	142	142
	1005	1005	1005	7603	142-Z	143	143
	1005	1005	1005	7603	142-Z	CC-6	—
	1005	1005	1005	7603	NPT-85	CC-6	—

8 occurrences of Census Tract 142-Z and 2 of Census Tract NPT-85. For the entire spreadsheet, larger than the snippet shown in the table, these two tracts appear a total of 16 and 4 times, respectively; thus, half of the 1960 population of each tract was assigned to Census Tract 1005. The 1960, 1980, and 2000 population data were extracted as GIS databases to be used in urban growth models.

The growth of the Chicago metropolitan area is shown through changing density patterns in Figure 3.12. Initially, the suburban population shows a strong sector orientation. Over

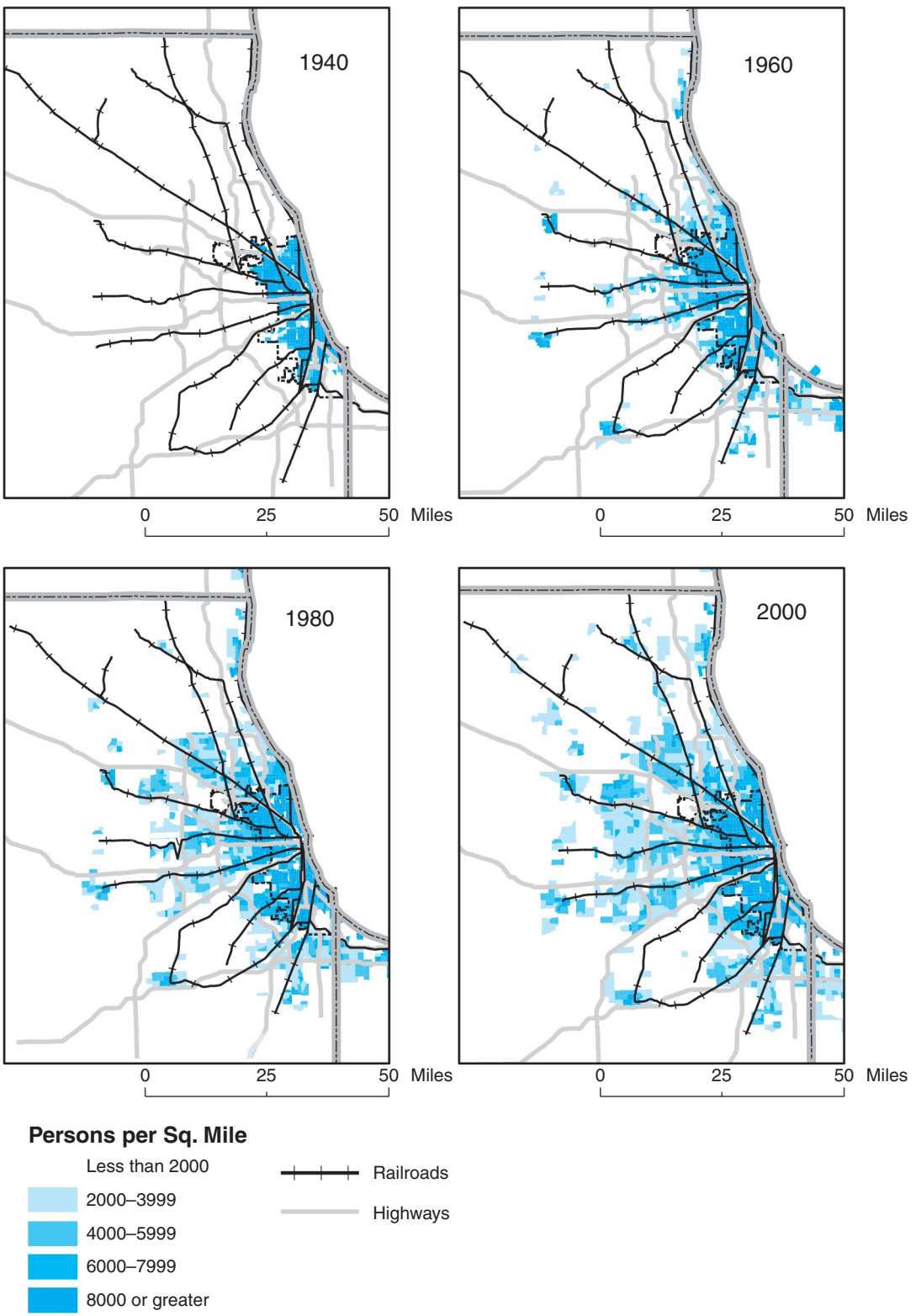


FIGURE 3.12 Patterns of density growth of the Chicago metropolitan area, 1940 to 2000.

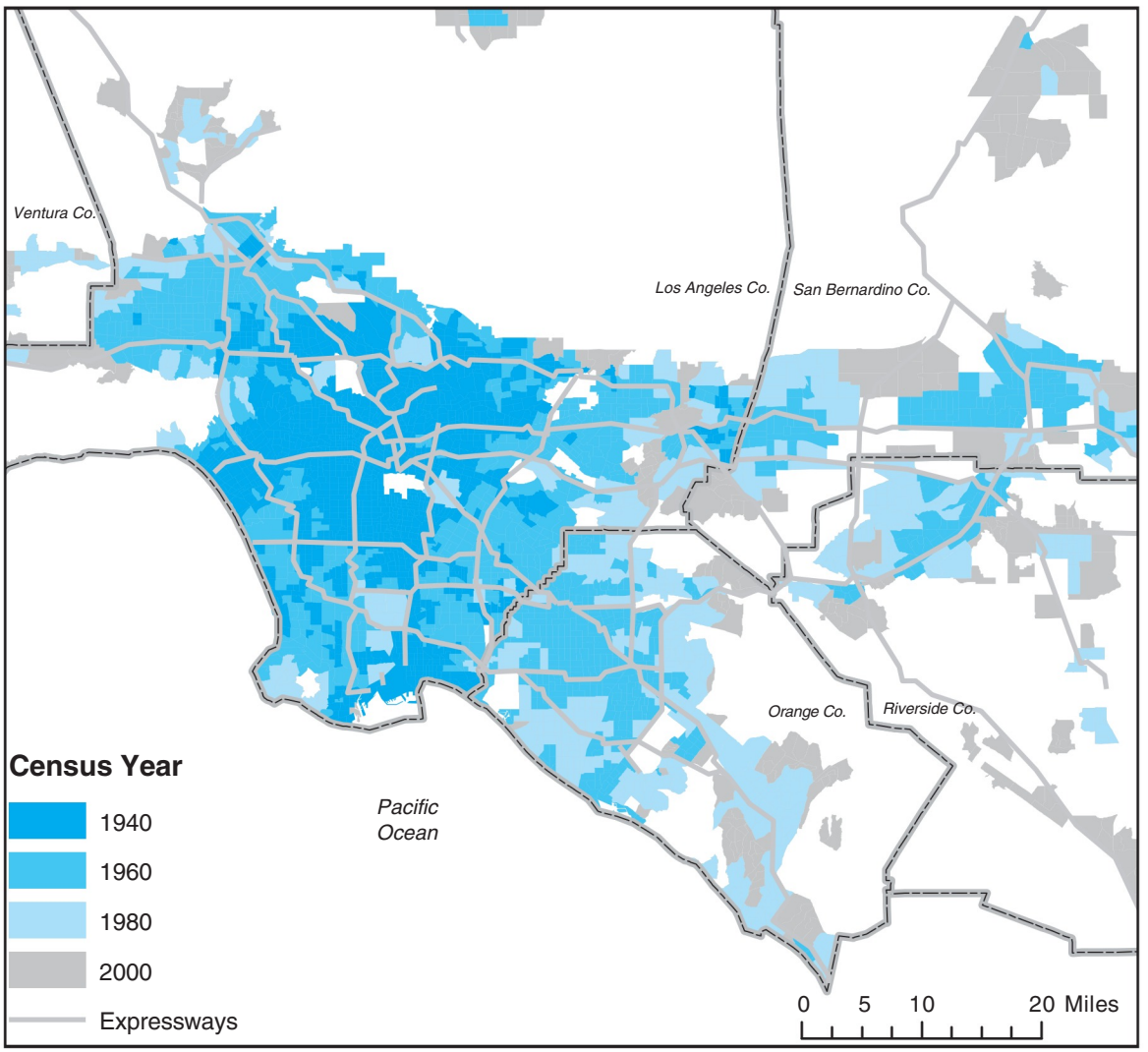


FIGURE 3.13 Patterns of density growth of the Los Angeles metropolitan area, 1940 to 2000.

time, the population disperses, filling in the areas between the transportation routes. The growth pattern in Los Angeles is similar (see Figure 3.13), but the terrain of southern California constrains the dispersion. The figure shows, for each census year, the area where density exceeds 1,000 persons per square mile. It is evident over this time period that the density patterns have followed the expressways. For Chicago, the suburban population living within 1 mile of the commuter railroads declined steadily over time from 1960 to 1990 (see Figure 3.14). This result would be expected as the automobile has become a more important transportation option, aiding in the dispersion of the population. This period also saw great increases in suburban employment concentrated in and around edge cities. This served to decrease the importance of the commuter railroads that were constructed to connect downtown businesses with suburban employees, but also resulted in no connectivity from suburb to suburb.

In both Chicago and Los Angeles, the changes in the percentage of people living within 3 miles of a limited-access highway display a similar pattern. As the picture shows, automobile traffic along major highways into cities is fed by limited on- and off-ramps (Figure 3.15). In both the Chicago and the Los Angeles cases, the percentage of people living close to the existing built-out highway system shows a sharp increase from 1960 to 1970 (see Figure 3.16a). After this rise, the percentage remains fairly steady, declining slightly over time.

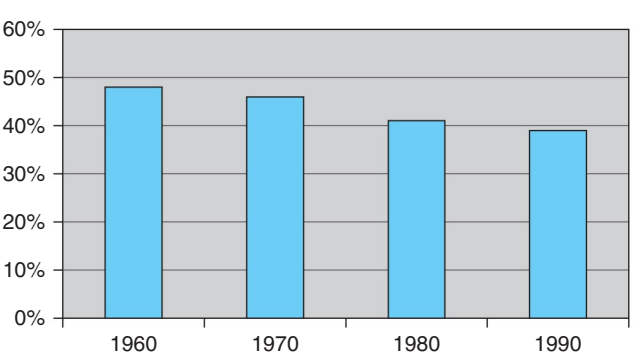


FIGURE 3.14 Share of suburban Chicago metropolitan area population living within 1-mile rail buffer, 1960 to 1990. *Source*: Piet, P., and Greene, R. P. (2000). "Population growth and the transportation link: Large city comparisons between the humid east and arid west." *Forum of the Association of Arid Lands Studies* 16:45–52.

FIGURE 3.15 Commuting to Chicago.

This supports the commonly held idea that highway construction will fuel population growth as people utilize the easier access to relocate farther from their place of employment. It also conforms to the Hoyt sector model, according to which households move in corridors, often transport or amenity corridors. However, if we look at the percentage over time of the suburban population residing within 3 miles of the 1990 built-out highway system, a different story begins to emerge. As illustrated in Figure 3.16b, the share of the population living within this corridor was highest in 1960 and has declined steadily since then. This indicates that the highways could also have been built to service an existing population, rather than simply serving as the conduit for growth. The story is identical for Chicago and Los Angeles, with Los Angeles exhibiting a consistently higher percentage residing near the highway, quite likely because of the constraints the Los Angeles physical landscape imposes on growth. The topographic obstructions literally force a higher density on all buildable land, including that close to the highways.

Transportation has had a profound effect on urban form, from the electric streetcar, which resulted in residential development conforming to rail lines, all the way to the automobile and its associated freeway network, which have resulted in a more dispersed urban form.

3.5 ANALYZING AN URBAN ISSUE: MEXICO CITY DENSITY

Mexico City's population density exhibits a unique pattern of development on the city's urban rural fringe due to the growth of illegal or squatter settlements, which can be illustrated with a density gradient. First, it will be useful to review the concept of an urban density gradient and its use in the study of urban structure. Clark (1951) is credited with bringing urban density gradient models, models that showed that urban population densities decline with distance from city centers, into wide use. With 36 cities as examples, Clark showed that urban population densities decline in a negative exponential manner with increasing distance from the city center:

$$D_x = D_0\, e^{-bx}$$

where D_x is the population density at distance x, D_0 is the population density at the center of the city, e is the base of natural

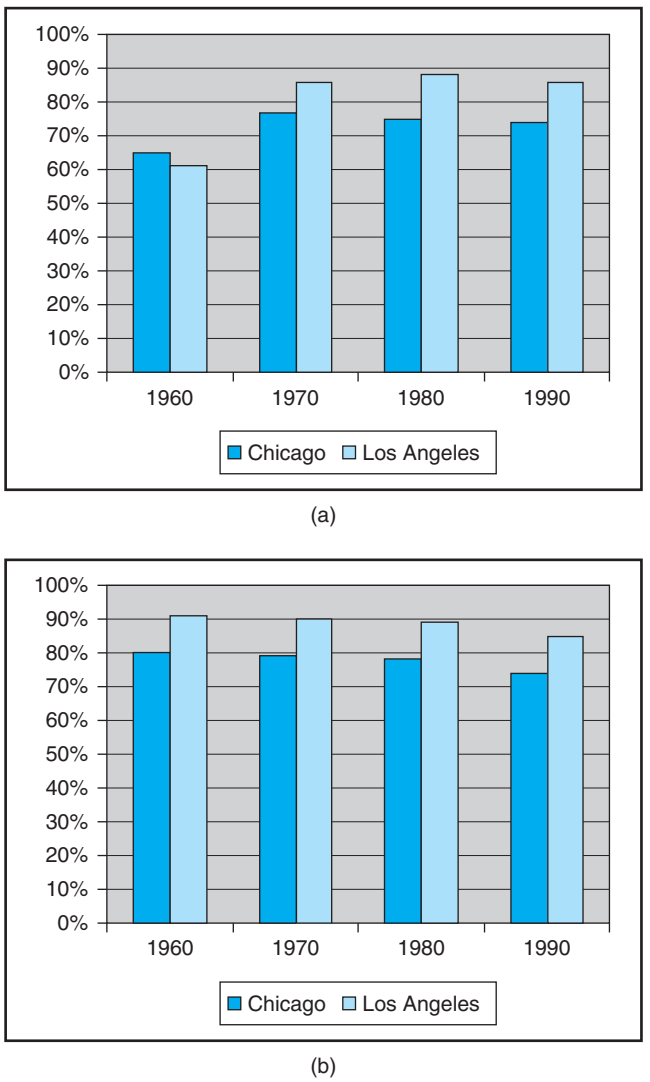


FIGURE 3.16 Suburban population living within a 3-mile highway buffer of (a) the built-out highway system as of the year shown on the bar and (b) the 1990 built-out highway system: Chicago versus Los Angeles metropolitan areas. *Source*: Piet, P., and Greene, R. P. (2000). "Population growth and the transportation link: Large city comparisons between the humid east and arid west." *Forum of the Association of Arid Lands Studies* 16:45–52.

logarithms, and b (density gradient) is an exponent expressing the rate of change of density with distance x.

Taking natural logs of both sides of this equation results in

$$\ln D_x = \ln D_0 - bx$$

Clark and others showed that this equation approximated a pattern of urban densities that had been replicated in a large number of cities. Nevertheless, the parameters of the equation, the extrapolated central density and the gradient, do vary across urban systems. One factor that contributes to regional variations in these parameters is the age of the city. Adams (1970) demonstrated for the American urban system that older cities have higher central densities and steeper density gradients than do younger cities (see Figure 3.17). For

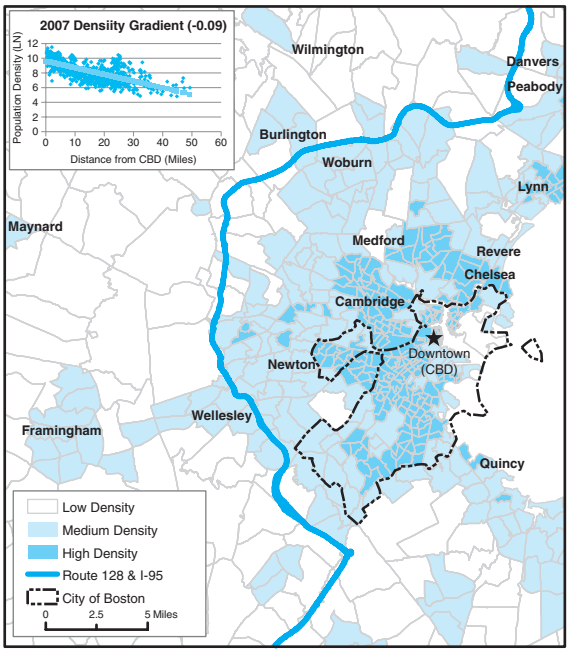


FIGURE 3.17 Boston 2007 density gradient. *Data Source*: ESRI 2007 population estimates for census tracts.

instance, Boston is expected to have a steep density gradient because it is in the Northeast, where cities are generally older than those in the Midwest, South, and West, all of which developed as the urban settlement frontier advanced westward:

> Yet when age and size data are plotted some general locational regularities can be displayed. The old cities of the East Coast occupy one section and the new cities of the West, Southwest, and the Gulf Coast occupy another cluster. Between the two is the zone occupied by Midwestern cities, founded in the nineteenth century during the middle period of American urban history. (Adams, 1970, p. 41)

Adams noted that the relationship between population density and age was due in large part to the transportation technology available to urban residents during the period of the city's most rapid population growth. Boston experienced rapid growth early in the pre-auto and pre-rail era, which helped account for its high-residential-density infrastructure. Even today, the urban infrastructure of this period has persisted, as evidenced by the population densities that can still support an extensive public transportation system best epitomized by the Boston subway network. In contrast, a place like Dallas (see Figure 3.18) experienced most of its growth and development well into the auto–air–amenity epoch and would exhibit a shallow pitch in its density gradient. Its public transport system is not as well developed as that of Boston.

Another finding regarding urban density gradients is that smaller cities have steeper density gradients because they are more compact than are bigger cities. Yeates (1990) made a similar finding with respect to land consumption rates (LCRs), which he found to decrease with city size. The LCR is the amount of

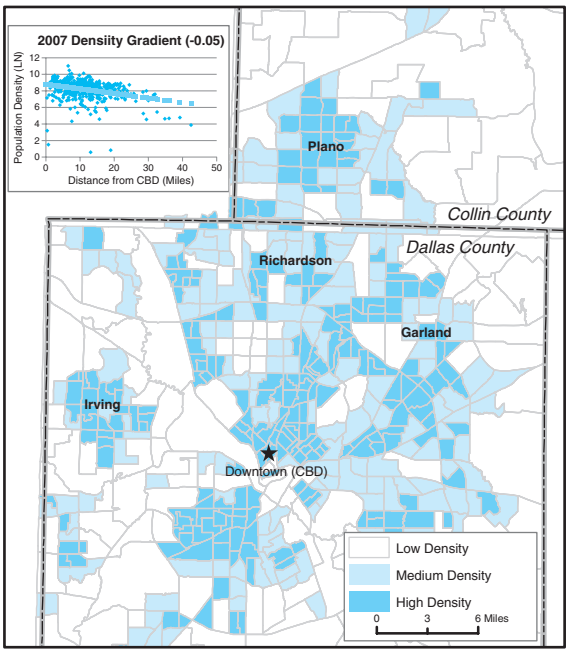


FIGURE 3.18 Dallas 2007 density gradient. *Data Source*: ESRI 2007 population estimates for census tracts.

urban land per urban population, or the reciprocal of population density. Yeates interpreted this as the efficiency of large cities, where the competition for land is much greater, resulting in higher land prices and hence the higher intensity of use.

A final finding regarding urban density gradients is that within a given city they become flatter over time (see Figure 3.19). Clark and others observed that over time the density gradient of a city became shallower as the population of the city increased and as the built-up area grew outward. Clark (1951) presented evidence suggesting that this relationship was true for London and Chicago. Berry and Horton (1970) showed that the shallowing trend of density gradients continued for Chicago through the 1960s. Newling (1969) established an axiom for the decline:

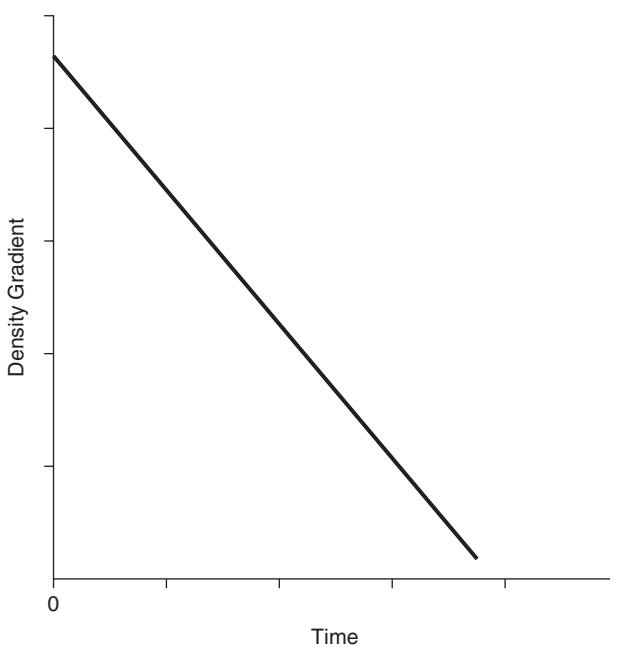


FIGURE 3.19 Relationship of the density gradient and time. *Source*: Newling, B. E. (1969). "The spatial variation of urban population densities." *Geographical Review* 59:242–252.

> The density at the center of the city rises and falls with the passage of time; the *b* parameter increases from negative to positive values with time; and the radius (and, inferentially, the area) of the urbanized area grows with time. Such a pattern may be described as displacement growth, since the city grows and spreads outward by the radial displacement of the density profile associated with the movement of people from the central city to the suburbs. (p. 250)

The application of the density gradient to the developing world has yielded somewhat different results than have the developed world examples (Berry & Kasarda, 1977; Wang & Zhou, 1999). In the case of the urban area of Calcutta, Berry and Kasarda (1977) found that the density gradient did not tend to flatten out over time as observed for cities of the developed world. By examining the period 1881 to 1951, Berry and Kasarda (1977) observed that, although central density increased and the urbanized area expanded, the density gradient remained constant. The flattening out of the density gradient in the cities of the developed world has been explained by the process of redistribution from the centers of cities to their edges, with resulting decreases in crowding. The results for Calcutta suggest that the city has remained compact and crowded through time, perhaps a result of less expansion on the periphery relative to what has normally occurred in the cities of the developed world. However, the findings for Calcutta might not be generalizable to all cities of the developing world, as Wang and Zhou (1999) found that Beijing's density gradient became flatter over time, while its extrapolated central density dropped between 1982 and 1990. Later Feng, Wang, and Zhou (2009) extended the time line of the Beijing analysis and found that the flattening out of the gradient was due principally to Beijing becoming polycentric, with seven distinct centers, as a result of China's reforms toward a market economy.

In the chapter's GIS exercise, a population density gradient is calculated for the Mexico City urban region for 2000 to establish whether it conforms to the developed-world pattern or the developing-world pattern. According to Griffin and Ford (1993), by the end of the 1970s Latin America was the most urbanized region in the developing world, with more than 69 percent of its population living in cities. The Mexico City urban area reached 19.0 million people in 2009, making it the third largest city in the world according to the United Nations (2008).

Urban life in Latin American cities is generally centered on the main plaza, and employment opportunities are concentrated in the city center. Also, in most of Latin America, cities were administrative centers and market towns that did not experience rapid immigration or industrialization during

Urban Population Density and Natural Hazards: The Case of Port-au-Prince

The aftermath of the January 12, 2010, earthquake in Haiti is an example of the dangers associated with urban population densities characteristic of the developing world, as seen in Haiti's capital of Port-au-Prince, especially when a natural disaster of that magnitude strikes (see Figure 3.20). A month after the Haiti earthquake, an even stronger earthquake shook parts of Chile, but the damage and loss of life were less, not only because Chile had better building standards, but also because the population close to the epicenter was not as densely settled as it was in Port-au-Prince. Over 200,000 lives were lost in the Haiti earthquake, and many of them had resided in the densely populated neighborhoods of Port-au-Prince.

The maps and satellite imagery of Port-au-Prince that appeared in news media coverage of the Haitian earthquake showed the world firsthand what developing-world urban population densities look like. Figure 3.21 is from a published .kml file that was placed on Google Earth's gallery page during the earthquake aftermath. Not only did it show the more than 1,000 collapsed buildings in Port-au-Prince that the author catalogued with aerial photo interpretation, but also it showed their spatial relationship to temporary refugee camps set up for the thousands of people made homeless by the event. The maps themselves also demonstrate participatory GIS in action, a topic covered in Chapter 5, since the maps were produced by a person knowledgeable about spatial data who wanted to contribute to spatial awareness and assist in the volunteer relief effort by disseminating the information freely through Google Earth: "I have plotted collapsed buildings on some area damaged by current earthquake by using 'old image' on Google Earth. I would like to contribute to recovery from this disaster. I will be so glad if you think they will be available and you could utilize these data" (Fujisan 777, 2010).

The United Nations Secretary General appointed former U.S. President Bill Clinton to coordinate the reconstruction effort in Port-au-Prince. While accepting the responsibility, Clinton also noted the extent of the effort that would be required: "'I think the challenges are great; we still have a lot of emergency problems to deal with,' he said. 'Almost all the infrastructure [is] gone there, so the trick is to get the Haitian people back where they can stop living from day-to-day and start living week-to-week or month-to-month'" ("President Clinton to oversee Haiti relief," 2010).

From an urban geography and planning perspective, the reconstruction will surely impact the future density gradient of Port-au-Prince as the city puts in place recommended building codes and carefully monitors development through a permit process (Basu, 2010). But as the Berry and Kasarda (1977) study found for Calcutta, India, developing-world cities have remained compact and crowded through time, even with rebuilding projects.

FIGURE 3.20 Collapsed buildings in Haiti. *Source*: flickr Yahoo.

⊡ Collapsed Buildings

⚠ Refugee Camp

FIGURE 3.21 Collapsed buildings and refugee camp in Haiti. *Source*: Fujisan777. (2010). Published .kml file at Google Earth's Gallery Page. Available at *http://www.google.com/gadgets/directory?synd=earth&hl=en&gl=en&preview=on&url=http%3A%2F%2Fmaps.google.com%2Fmaps%2Fgx%3Foe%3Dutf-8%26output%3Dghapi%26q%3Dhttp%253A%252F%252Ffujisan777.sakura.ne.jp%252FKML%252FHaiti_HouseDamage.kmz*

the 19th century. Consequently, they did not experience the same type of urban growth and structural change as did the cities of the United States and Canada. Latin American cities generally remained specialized, traditional, and relatively small. There were other factors limiting their growth. For instance, the urban elite were concentrated in the core and the low-income majority on the periphery. Urban areas remained compact, as the spread of the city was often associated with lower standards of living for those living on the periphery (Griffin & Ford, 1993). Although Mexico City has shown some tendency toward polycentricity, a study of job centers throughout the metropolis has shown that it is still predominantly centralized (Suárez & Delgado, 2009). This is because the sub-centers of a polycentric model accounted for only 2 percent of metropolitan jobs when the informal labor force was recognized, while 70 percent of jobs remained located in the central part of the metropolis.

Griffin and Ford (1993) developed a model to describe this process and urban structure (see Figure 3.22). The center of the city is occupied by the CBD, similar to U.S. and Canadian cities. In contrast to them, however, the CBD in Latin American cities has remained the center of most employment, as well as commercial and entertainment life. Also characteristic of the Latin American city is a commercial spine. The spine is an extension of the CBD and is lined with upper-class and upper-middle-class housing in addition to high-rise office buildings. Socioeconomic levels and housing quality decrease with increasing distance from the CBD in Latin American cities, which is the inverse situation from the typical North American city. Another notable difference between Latin American cities and North American cities is the development of large squatter settlements on the urban periphery that house the poor, many of whom have recently arrived from even poorer rural conditions (Wigle, 2010). In these settlements, most residents live in makeshift housing built illegally and often lacking proper sanitation.

Aguilar (2007) researched the squatter settlement issue for Mexico City and found that it is of particular concern to the area south of the city center in a preservation zone with ecological issues in terms of climate regulation, water recharge, forest communities, agricultural cultivation, and hilly landscapes. The study identified and measured 2,098 illegal settlement polygons in 2005, at the end of the 1995–2005 study period, using aerial photography. Moreover, the study found that the main illegal expansion was happening in areas outside the traditional towns, in zones where urban development was prohibited.

Another issue on the periphery involved resolving urban expansion with local customs and history. Wigle (2010) did a case study of the area Ampliación San Marcos on the southeast periphery of Mexico City. This former rural area was urbanized by the converging expansion of Mexico City and growth of a pre-Hispanic town nearby. The study found that the urbanization process in this peripheral settlement was not a generic process, but very much keyed to the history and culture of this particular area. It was "influenced by longstanding *in situ* social relations and practices related to property" (Wigle, 2010, p. 412). There were longtime processes for the transfer of *chinampas* land, a type of shared property of informal communities. *Chinampas* dated from the 10th

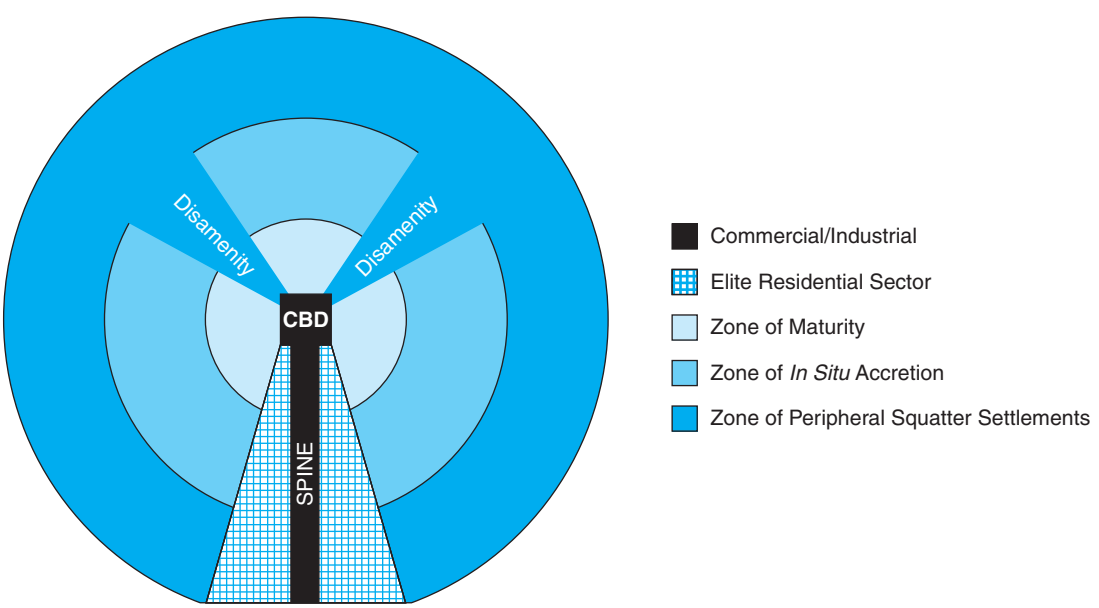


FIGURE 3.22 Latin American city model. *Source*: Griffin, E. and L. Ford, 1980. "A Model of Latin American Urban Use." GEOGRAPHICAL REVIEW 70:397–422. Figure 4. p. 406. Reprinted by permission of American Geographical Society. "A Model of Latin American City Structure."

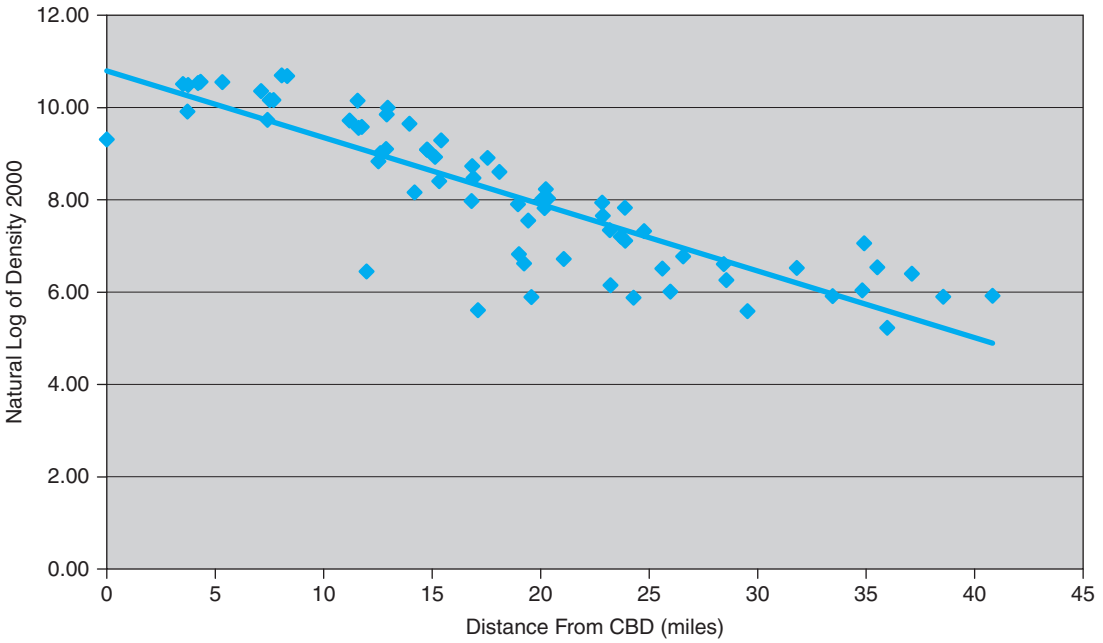


FIGURE 3.23 Mexico City density gradient, 2000.

century and were human-designed agricultural plots that took advantage of nearby freshwater canals. The study details the complex real estate compromises and agreements that finally in the 1980s allowed for the development and building of housing on this land.

With these structures in mind, we now turn to the analysis of Mexico City's density gradient for 2000 (see Figure 3.23). In some respects, the density gradient pattern is consistent with previous observations made about cities of the developed world. Nevertheless, high-density outliers on the urban area edge appear on the Mexico City density gradient graph, confirming elements of the Latin American city model; that is, it can be concluded that these outliers on the edge have the density characteristics of squatter settlements. In the exercise, mapping four of the outliers with especially high densities, given their distance from downtown, will provide evidence of them as potential squatter settlements (see Figure 3.24).

3.6 CONVERGENCE AND DIVERGENCE FROM THE CLASSIC MODELS: THE CASE OF CHICAGO

We now turn specifically to a case study of the city of Chicago, with some comparisons to the city of Los Angeles, to illuminate the urban processes. This section attempts to tease out the many processes identified by the contemporary adherents of the Chicago School as being on par with those identified by the L.A. School for Los Angeles. The city of Chicago showed remarkable growth during the 1940s, when it added almost 225,000 people (see Figure 3.25). It was remarkable because of the extreme stability exhibited in the 1930s, but more important, Chicago's city population would reach its all-time decennial census peak of 3.6 million people by 1950. Subsequently during the 1950s, Chicago would lose about 70,000 people before undergoing a deep descent that would last through 1990, the date that Los Angeles officially replaced Chicago as the nation's second largest city (see Figure 3.25). In the Chicago metropolitan area overall, the city's share of the total metropolitan population had fallen to 43 percent by 1970 (see Figure 3.26). The rate of loss in Chicago accelerated from the 1950s to the 1960s and again in the 1970s, when it reached its all-time-high decennial loss of 362,000 persons. However, in the 1980s, the rate of loss in Chicago slowed, with a loss of approximately 220,000 persons.

Reversing this long trend, the central city of Chicago expanded in population between 1990 and 2000, the first time it had done so since the 1950 Census. Chicago's 1990s metropolitan population spurt of 11.1 percent is much higher than the city growth rate of 4.0 percent, indicating that the area outside the central city is continuing its post-1950 trend of rapid growth. In 2000, the city's proportion of the metropolitan area declined to only 32 percent.

Plotting density gradients through time is another way to illustrate urban development trends within a metropolitan area (see Figure 3.27 on page 95). The literature on this subject argues that the gradients should become flatter through time as filling-in occurs between the dense core and the less dense fringe. Although that happened for Chicago recently, it was only slight. An especially notable difference between Los Angeles and Chicago is the slope of the density gradient from their downtowns to the edges of their metropolitan areas.

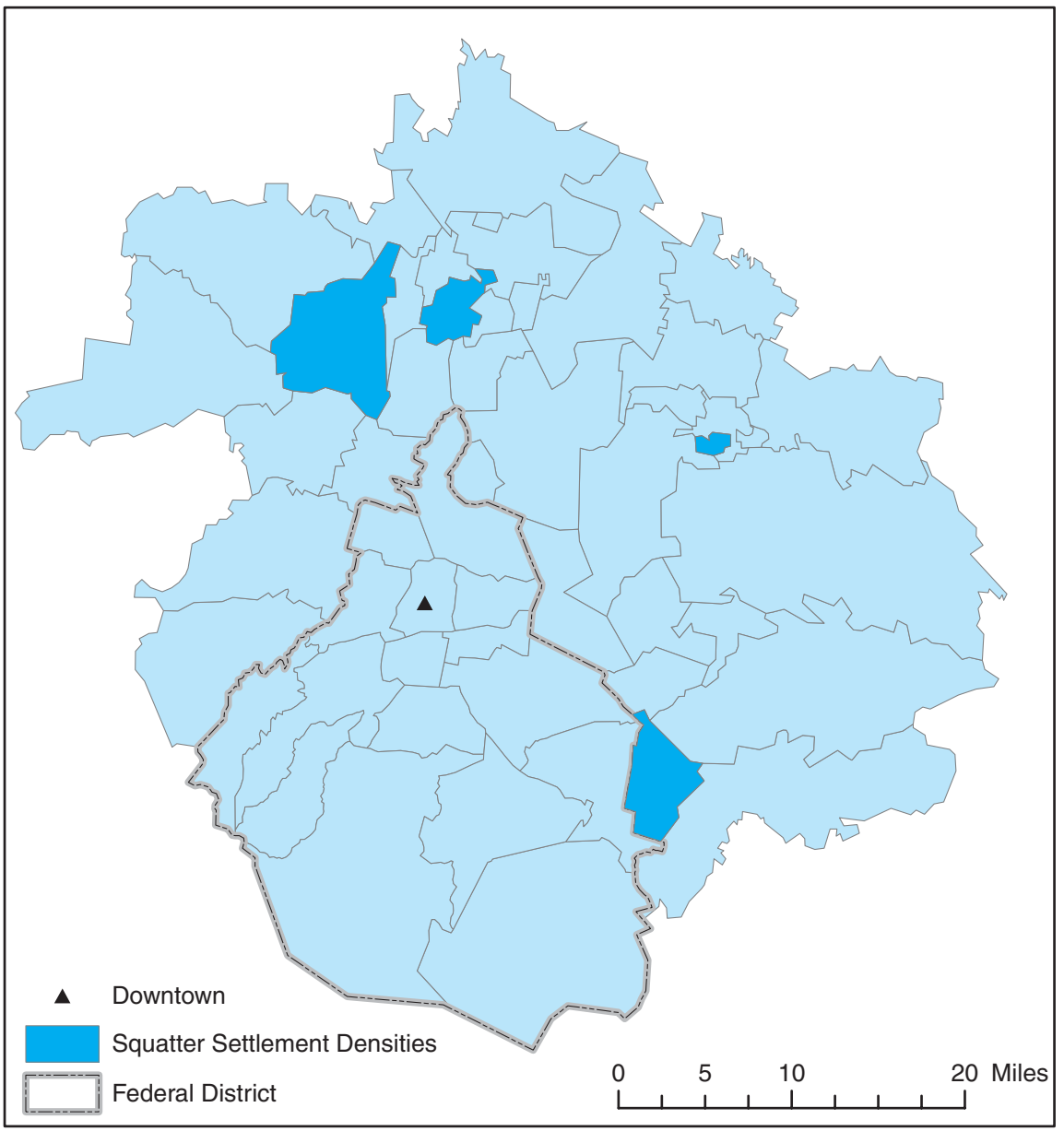


FIGURE 3.24
Peripheral areas of Mexico City with potential squatter settlements.

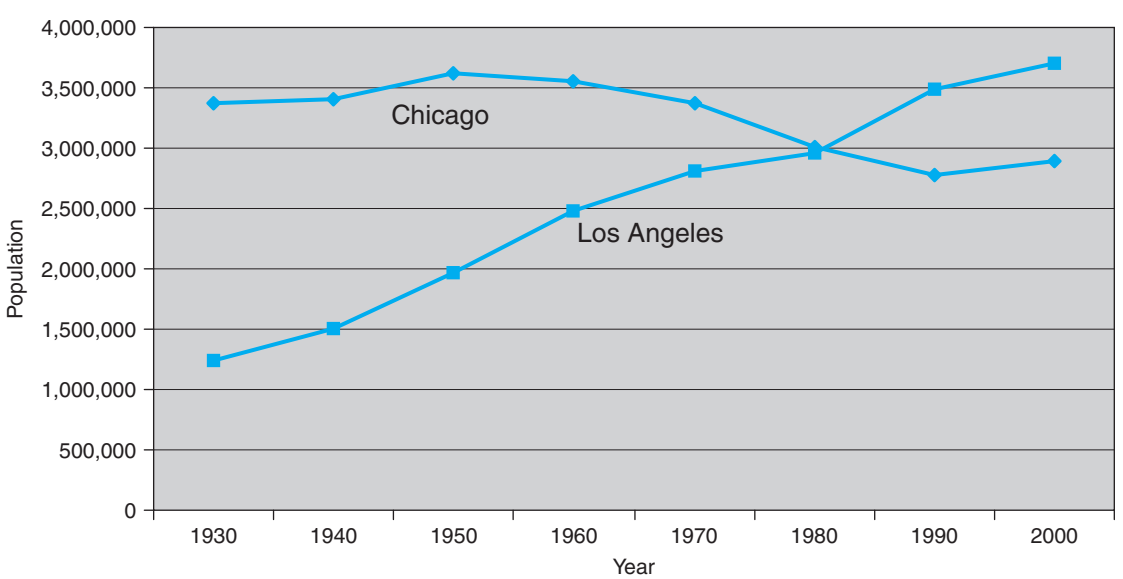


FIGURE 3.25
Population growth of the city of Chicago versus the city of Los Angeles. *Source*: U.S. Census 1930 to 2000.

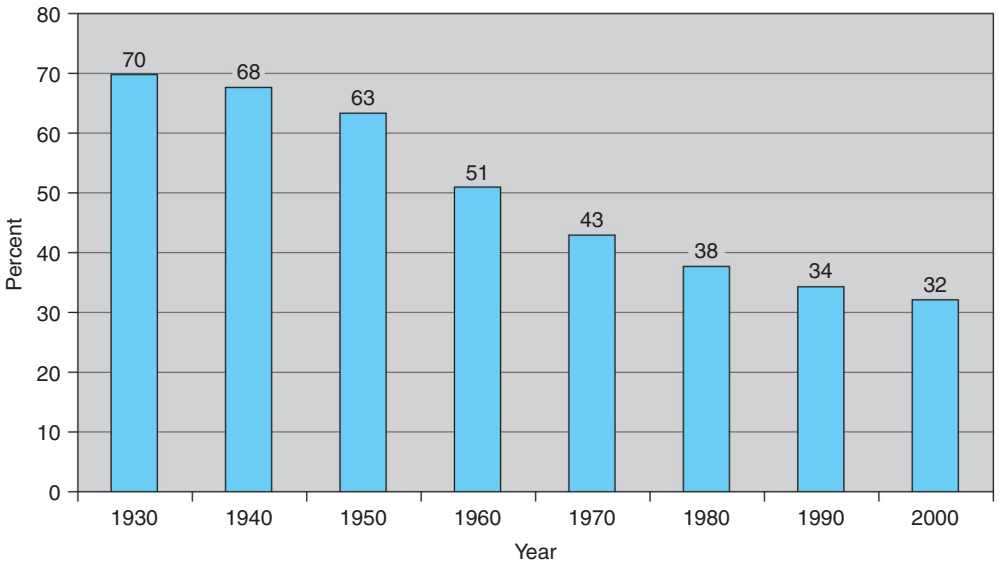
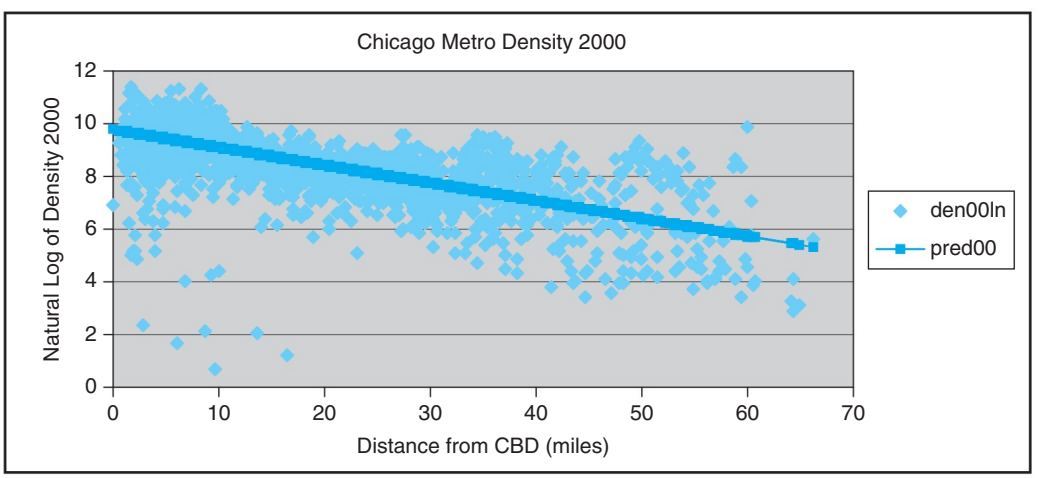
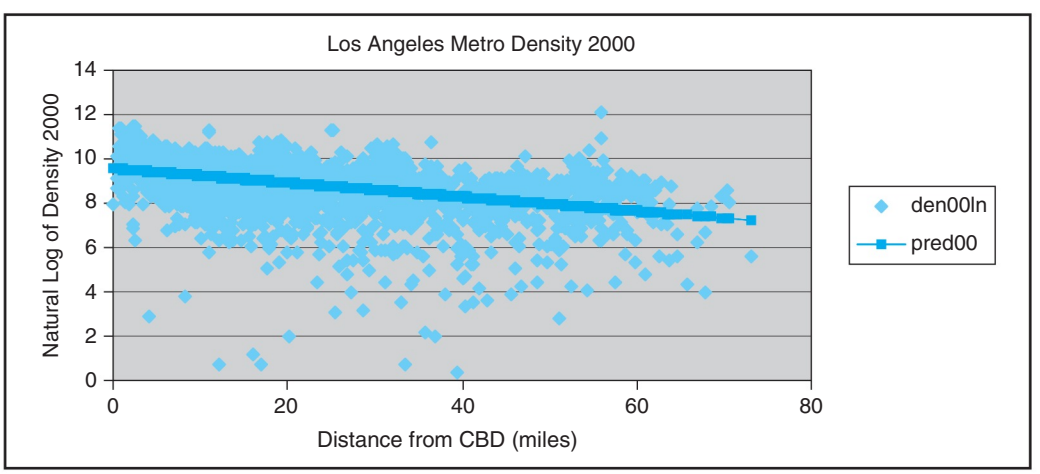


FIGURE 3.26 City of Chicago's share of 13-county metropolitan population, 1930 to 2000.
Source: U.S. Census 1930 to 2000.



Extrapolated Central Density = 9.77 Density Gradient = – 0.067



Extrapolated Central Density = 9.56 Density Gradient = – 0.032

FIGURE 3.27 Chicago and Los Angeles density gradients, 2000.

Note the steeper gradient for Chicago, caused by more observations in the high-density and low-density categories, especially over 40 miles from the CBD, than for Los Angeles, with many tracts in the medium-density categories. This is because there is more high-rise and multifamily housing in Chicago, accounting for relatively high densities in the core. The Chicago metropolitan area also includes large low-density areas, providing plenty of room to grow. Los Angeles, on the other hand, has largely run out of a low-medium- to low-density urban fringe, due to being hemmed in by mountains, deserts, and ocean, as shown by the National Aeronautics and Space Administration (NASA) image of the central area in Figure 3.28. Clearly, competition for land is much greater in a metropolitan area like Los Angeles, so the distribution of its tract densities is more concentrated.

To illuminate the components of growth for Chicago in the 1990s within this first 10-mile ring from downtown, the map in Figure 3.29 shows 1990 and 2000 extreme poverty area patterns. At first, it might seem odd to consider population growth in the context of poverty, but this is relevant because much of the 1990 research on these areas showed massive depopulation since 1980 and subsequent rises in the poverty level. The addition of the 2000 poverty areas shows that a remarkable contraction in the zone of extreme poverty had occurred in the 1990s, while population loss in the zone was only slight.

Analyzing the city's emerging immigrant areas, defined as tracts with a 1990 foreign-born population that had increased by at least 1,000 between 1990 and 2000, helps explain Chicago's rebound. To put this in perspective, consider that the

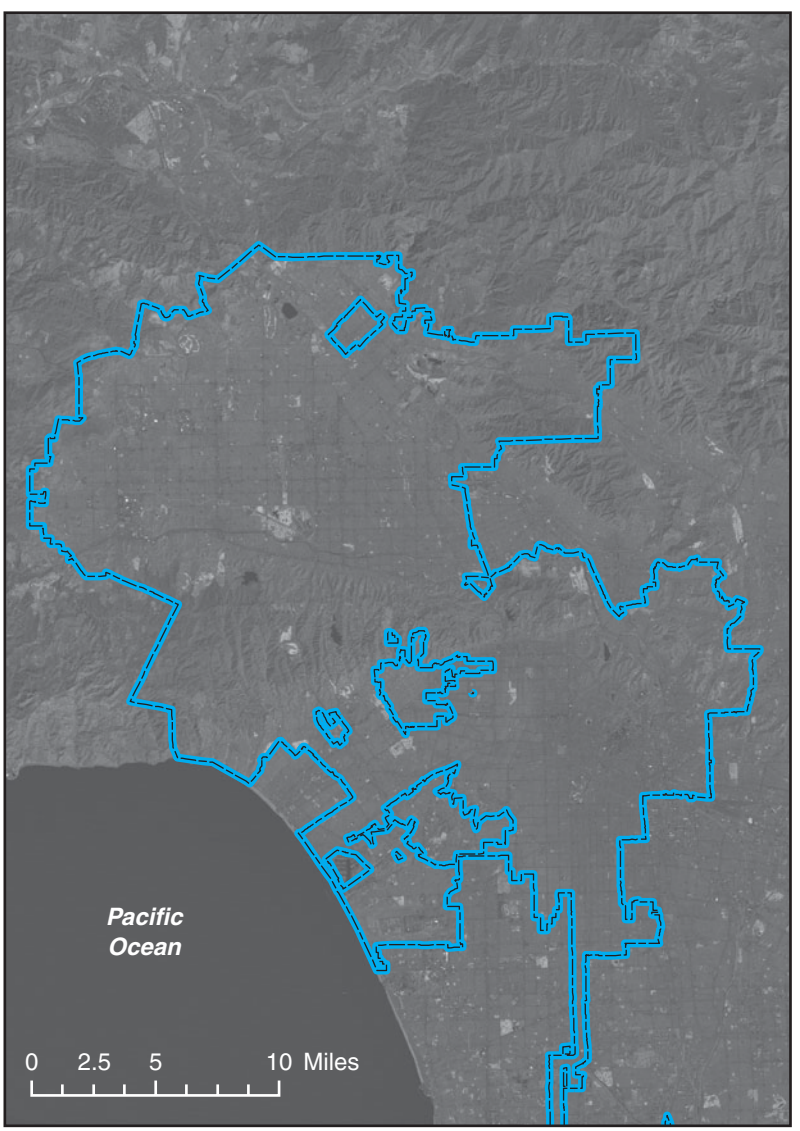


FIGURE 3.28 Landsat image of Los Angeles urban area with city boundary superimposed. *Source*: CalView Landsat Data: http://gis.ca.gov/ (date: 4 March 2002; bands: 4, 5, and 7).

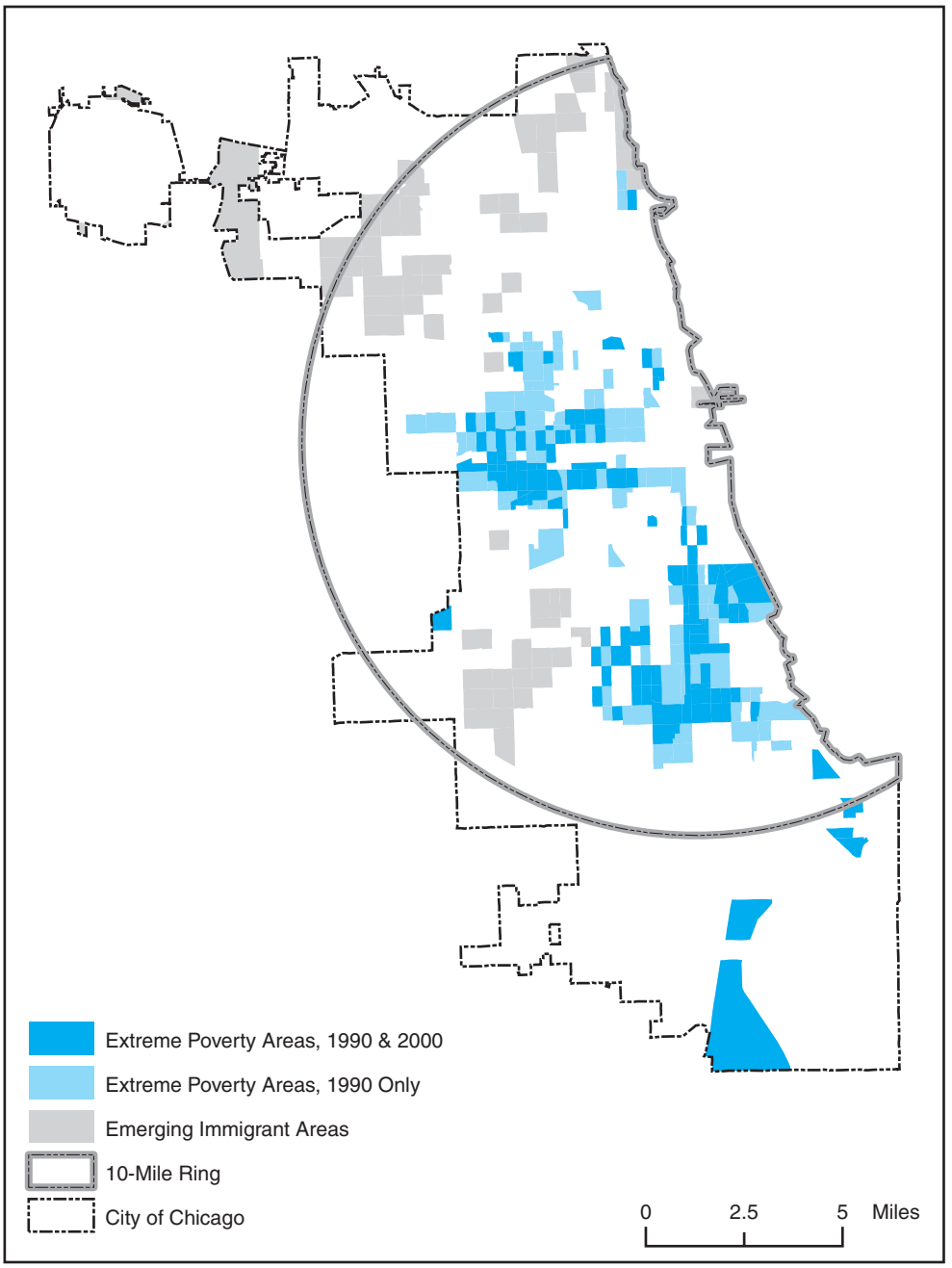


FIGURE 3.29 Chicago poverty and immigrant settlement areas.

city of Chicago's total population increase was 112,290 between 1990 and 2000. The total population increase of the emerging immigrant areas was 81,000, and their foreign-born population increased by 93,000, suggesting a decline in the area's native-born population. It is also interesting that the Latino increase in these areas was approximately 114,000, which might relate to nearness to employment centers, particularly in the northwest. Incidentally, these emerging immigrant areas are mutually exclusive of the extreme poverty areas westward and southward of downtown Chicago.

New immigrants are also locating close to edge cities in the Chicago area. As we saw previously, many of the old models describing the entrance of immigrants into cities recognized that the new arrivals moved into neighborhoods that adjoined either the CBD or close-in industrial districts. In light of the recent manufacturing job shifts out of central cities and the growth of employment in outlying edge cities, the change in the location pattern of immigrant settlement is not surprising. An edge city destination is likely to hold more economic promise for a new immigrant than is a neighborhood closer to the city that has experienced a decline in its industrial job base.

The maps in Figures 3.29 and 3.32 illustrate that a significant number of the Chicago area's new immigrants are

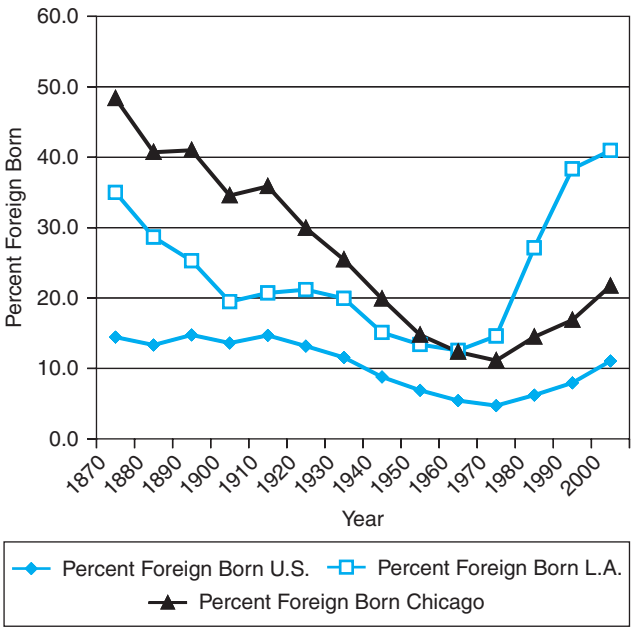


FIGURE 3.30 Percentage of foreign-born residents in Los Angeles, Chicago, and the United States, 1870 to 2000.

bypassing the traditional zone in transition, drawn by emerging job opportunities in the region's edge cities. In the absence of sufficient demand, some of these bypassed neighborhoods have fallen into a cycle of landscape dereliction, which is characterized by the decay of public infrastructure and large-scale housing abandonment. On the other hand, a number of these neighborhoods were rediscovered by gentrifiers in the 1990s, a topic discussed at greater length in Chapter 5.

During the 1980s and 1990s, the number of legal immigrants entering the United States rose sharply, and in 2000, approximately 12 percent of Americans were foreign born (see Figure 3.30). Twenty years ago this was significant news for Chicago because Illinois was one of six states receiving 75 percent of the approximately 8 million legal immigrants that had entered the United States during the 1980s. Once again, a Los Angeles comparison is in order here. Note that Figure 3.30 shows a downward trend in the percentage of foreign-born residents for both Chicago and Los Angeles from 1870 to 1960. However, prior to 1960, Chicago's percentage was always higher. Chicago's then continued to fall, whereas Los Angeles's began to rise and remained above Chicago's through 2000. Chicago descended for only one more decade and then made sharp ascents from 1970 to 1980 and 1980 to 1990, with its sharpest ascent from 1990 to 2000 (even sharper than that of Los Angeles for that decade only).

Chicago's suburbs and outlying industrial satellite cities have experienced large increases in Latino population in the last decade or two. The growth in Latino population was especially pronounced in Elgin (see Figure 3.31); confined mainly to the east side of the Fox River in 1990, the distribution had spread to the west side by 2000. In many respects, the spatial pattern exhibited by the growth of Latinos in Elgin, Illinois, is similar to that seen in much larger cities such as the 1970-to-2000 expansion of Latinos in Los Angeles. In Elgin, the older core of the Latino population was east of the Fox River. However, as middle-class non-Latino White households on the west side of the river moved out of Elgin and west along an established high-income sector, vacancies and better housing opportunities were created for the city's growing Latino population.

Emerging immigrant concentrations, defined as tracts that experienced increases of 1,000 or more foreign-born persons between 1990 and 2000, emanate outward from the city of Chicago, often adjoining many of the region's employment centers (see Figure 3.32). A substantial increase in immigrants outside the city of Chicago has shifted the geographic center of the region's immigrant population in a northwest direction, which is an orientation that corresponds to the directional shift in the Chicago region's overall population, jobs, and major ethnic groups, including Latinos and Asians (see Figure 3.33). The only apparent diverging movement is that exhibited by Blacks. The Black population of the Chicago region has been suburbanizing, as have all groups; however, Blacks' movement has been biased in the direction of the south and southwest sectors.

As with other very large U.S. urban areas, one of the most significant demographic trends for the Chicago region in recent decades has been population redistribution from the core of the region to its periphery, with the most recent decade showing a slight reversal of that trend. The most noticeable effect of this redistribution has been large-scale housing abandonment or neglect in many of Chicago's poorer neighborhoods. Some of these neighborhoods have experienced gentrification, the effect of which is picked up in the recent city population increases. Gentrification is an upcoming topic in Chapter 5. Meanwhile, the urban fringe on the outskirts of the metropolitan area has been the recipient of large-scale investment in its built environment. Although significant, the number of immigrants entering Chicago and its inner suburbs has not matched the growing redistribution of population to the edge. Also, new immigrants arriving in the Chicago region appear to be orienting themselves in proximity to the region's emerging job centers on the edge, but removed from even farther outlying scattered residential enclaves of the upper class.

In summary, in the Chicago urban area, population and economic decentralization have been long-term trends, with the exception of the growth period of 1990 to 2000, when the core experienced renewed growth. New immigrants are settling in a geographic pattern that is quite different from that of immigrant groups that entered Chicago in earlier periods, when its core was the major location for job opportunities. Today, immigrants entering the Chicago area encounter an industrial geography that is becoming increasingly dispersed. The high employment-growth rates in the outlying ring of municipalities surrounding the city of Chicago are an obvious magnet for new immigrants in search of job opportunities. The older and persistently low-rent areas of the west and

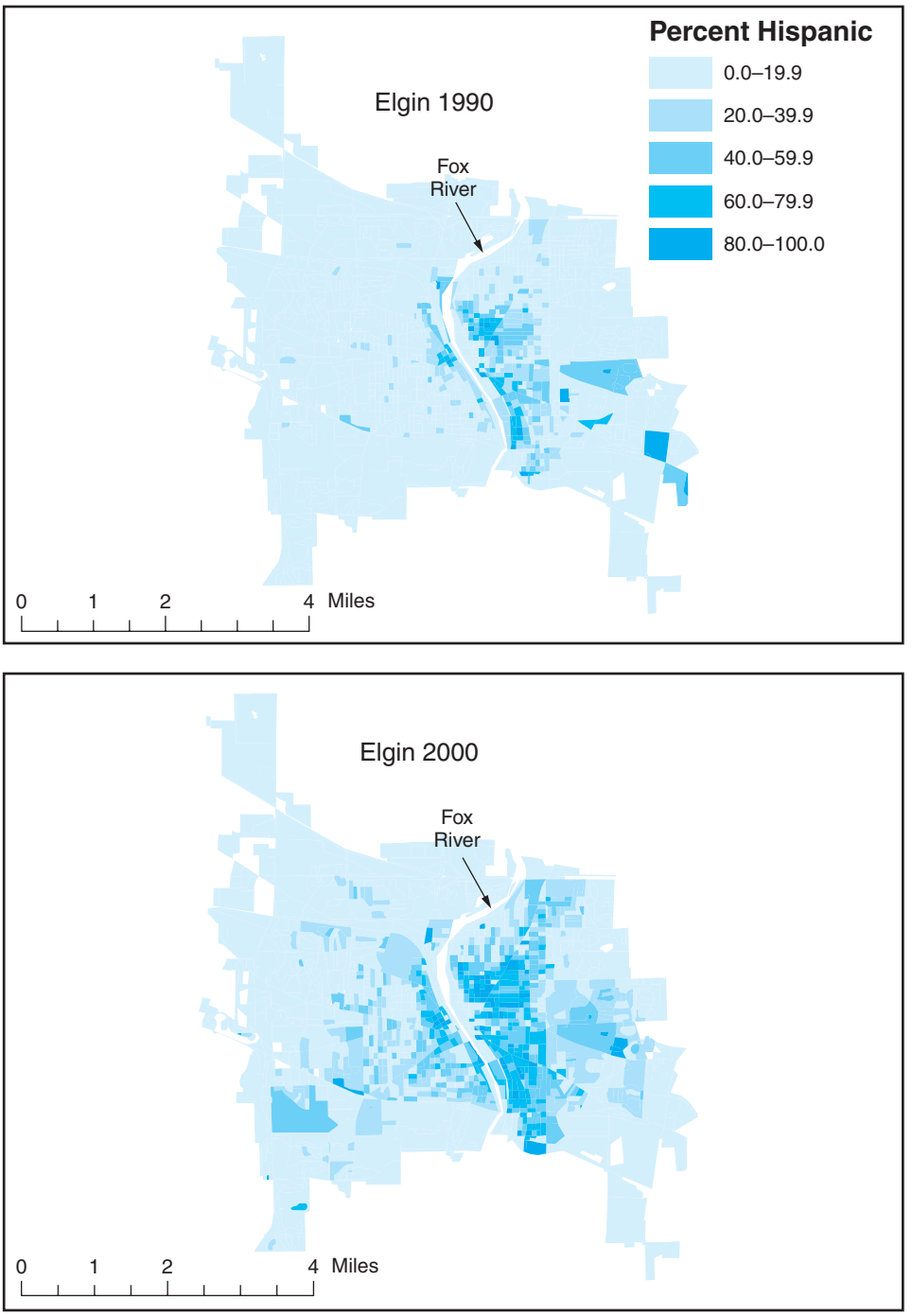


FIGURE 3.31 Change in the percentage of the Latino population in Elgin, Illinois, 1990 to 2000.

south, close to the urban center, are not attracting new immigrants at a sufficient rate to offset the recent population declines incurred there by the outward migration of the Black middle class to the suburbs. As a result, these old, bypassed neighborhoods are becoming the locus of the region's extreme poor, who are economically disadvantaged by location. The new immigrants, on the other hand, have been settling on the periphery of the region's traditional immigrant neighborhoods, as well as outside Chicago's city limits and are thus more strategically located relative to the region's geographic distribution of jobs. In addition, a countertrend of gentrification by young urban professionals and artists has contributed to the population turnaround exhibited by Chicago's core more recently.

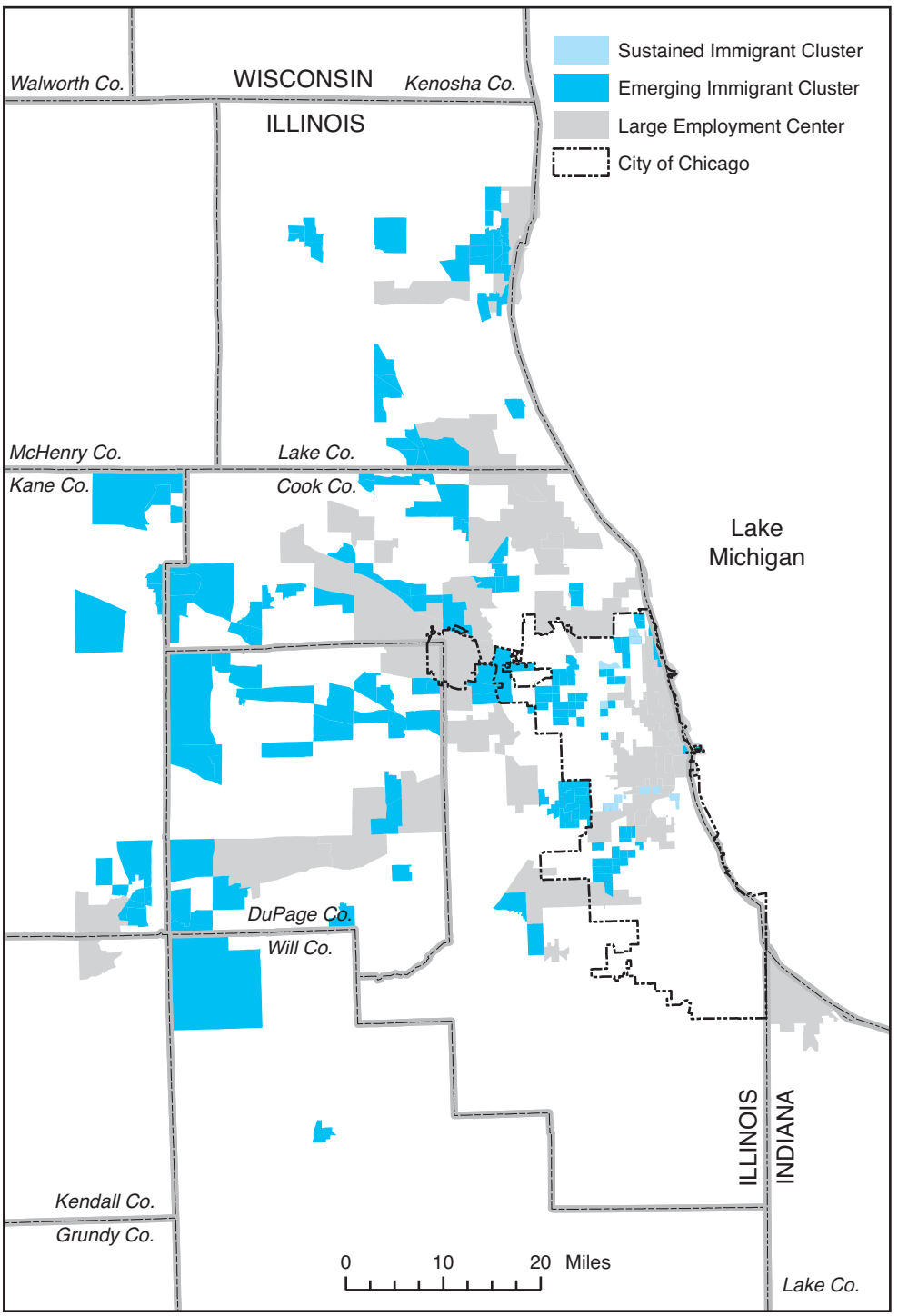


FIGURE 3.32 Immigrant clusters and job centers in the Chicago metropolitan area, 2000.

Summary

The internal structure of cities has always been a prime topic of interest to urban geographers. In the United States, the first formal model of the internal urban structure of cities can be dated to the Chicago School of sociology in the 1920s. The concentric zone, sector, and multiple nuclei models represent the classic American statements of how city distributions are organized and change. Today, there are both proponents and critics of these classic urban development models. Proponents continue to find evidence to support aspects of one or more of the three models, whereas critics argue that the models no longer reflect current-day urban processes. Historical development patterns for Los Angeles and Chicago show that the built-up areas

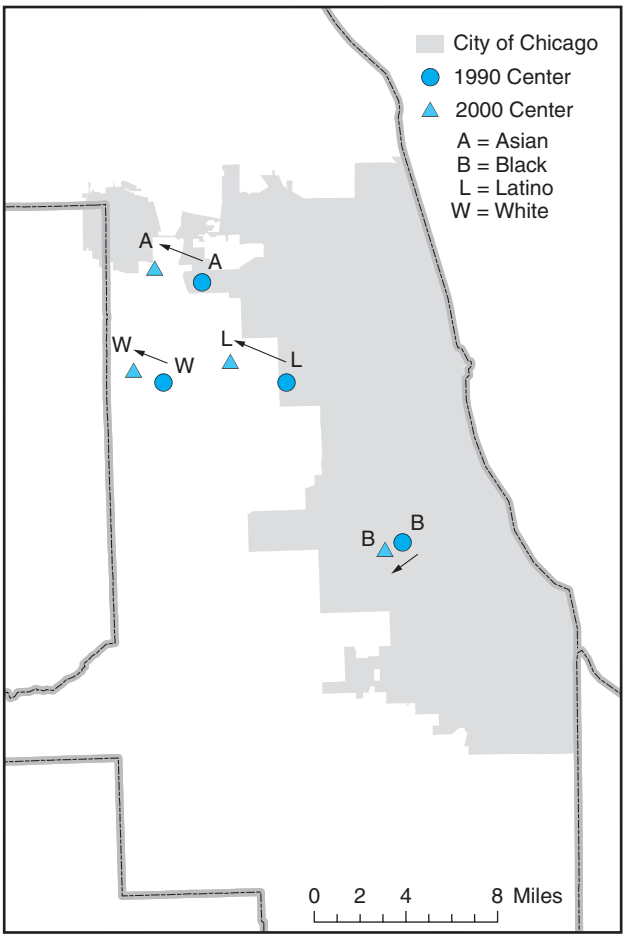


FIGURE 3.33 Shift in the population centers for the Chicago metropolitan area, 1990 to 2000.

advanced in patterns consistent with all three models. A review of recent trends in Chicago illustrates that many of the patterns of settlement identified by the earlier models are similar, but that the context has changed. For instance, on the basis of the Chicago analysis, one can argue that the zone in transition, originally located next to factories, has shifted to new and outlying employment centers such as O'Hare Airport, which is a major employment center for workers that include many new immigrants who live nearby and work in the service-related jobs associated with the airport.

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Exercise

Exercise Description

Identify squatter settlements in Mexico City by constructing and examining density gradients.

Background Information

In this lab, you make a density gradient for the Mexico City metropolitan area to see if it conforms to the Latin American city model of urban development.

Google Earth Version

Part 1: Compute a Density Gradient

You will use Microsoft Excel 2007 to compute the density gradient for Mexico City. You may need to install the Excel "Analysis ToolPak" add-in before you start.

1. Start Excel, and open Mexden.xls. Note that there are 50 *municipios* (rows 2 through 51) with the following fields:
   (A) map_index, (B) MUN_NAME, (C) P00_sqmi, (D) x_coord, and (E) y_coord
2. Add the following fields:
   (F) Distance, (G) den00ln, and (H) pred00
3. In cell F2, calculate the first *muncipio* to be the distance to the CBD in miles:

$$= \text{SQRT}((\text{d2} - \text{d\$15})^2 + (\text{e2} - \text{e\$15})^2)/1609$$

where d = x_coord, e = y_coord, 15 = row for Cuauhtemoc, and 1609 = conversion factor for meters to miles.

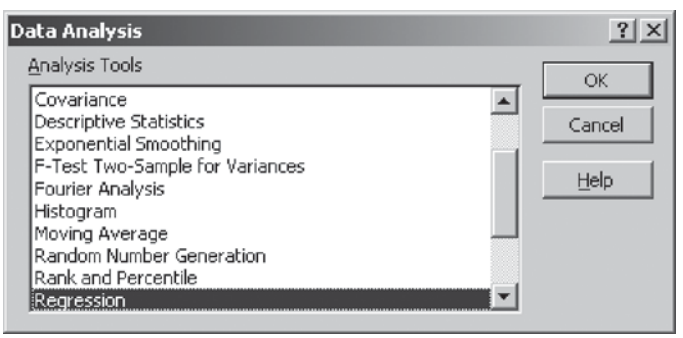
This step uses a simple geometry formula to calculate the distance from the center of a *municipio* to the downtown (Cuauhtemoc, which is the central *municipio*).

4. Copy the formula to the other cells downwards to row 51 by grabbing the lower right corner of the cell and dragging down.
5. Calculate the natural log transformation of population density for 2000 in cell G2:

$$= \text{LN(C2)}$$

Note: C2 is P00_sqmi, which is the population density in 2000.

6. Copy and paste the formula down to row 51.
7. At the top of Excel, click the Data Tab.
8. Click Data Analysis, select Regression, and click OK.



9. We will compute the 2000 density gradient by filling in the following dialog box with the following data ranges (you can click and drag on a column to input a data range):

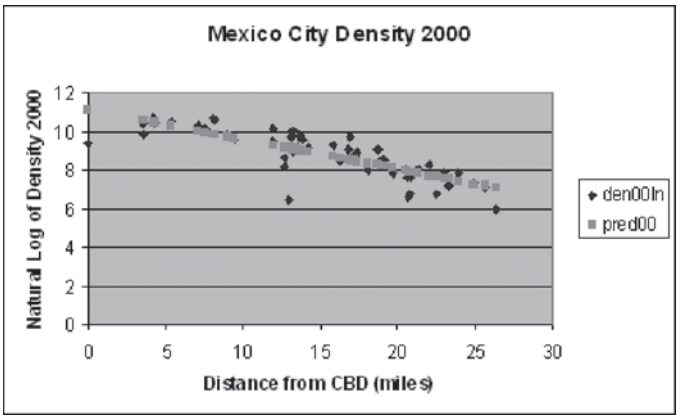
   For Input y-range, enter the range for den00ln (**$G$2:$G$51**).
   For Input x-range, enter the range for distance (**$F$2:$F$51**).
   Check Output Range under Output Options, and enter (**J1**).
   Click OK.

10. Excel computes the density gradient and puts the output in the location specified (J1).
11. The density gradient (line) can be thought of as the predicted density, or the density predicted given the distance from a *municipio* to the center of the city.
12. In cell H2, use the regression output to calculate the 2000 predicted density by multiplying the distance by the slope coefficient and adding it to the Y intercept:

$$= \text{F2*K\$18} + \text{K\$17}$$

where F = distance, K$18 = x variable, and K$17 = y intercept.

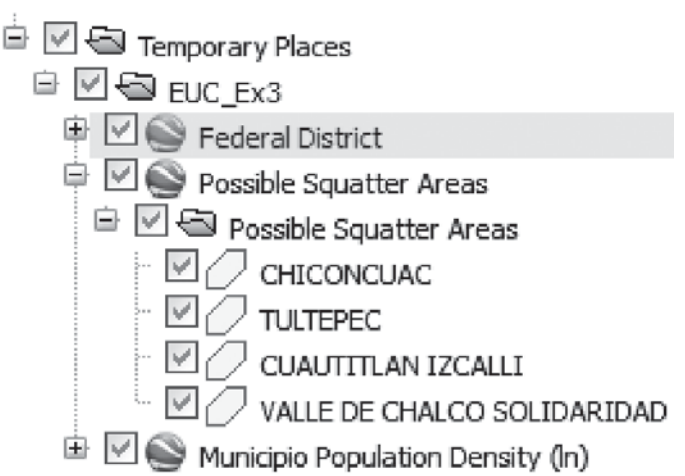
13. Copy the formula down to row 51.
14. Before we make a graph, select columns F, G, and H (to select these columns, click on F and hold the shift key and click on G and H).
15. Graph the gradient by clicking the Insert Tab at the top of Excel and then click the Scatter option under Charts.
16. Choose the first subtype that shows a plot of points.
17. Place the graph that appears in the spreadsheet out of the way of the numbers to the far right.



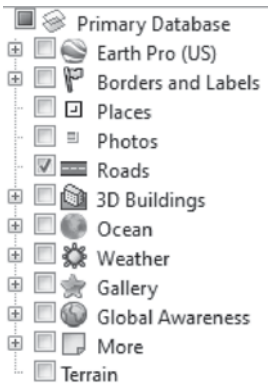
18. Click File and Save As an Excel Workbook with the File name MexdenV2.
19. Before you exit make sure that the graph is not selected and then click File and Exit Excel.

Part 2: View the Density Gradient Results

20. Launch the Chapter 3 Google Earth KMZ file by double-clicking it:
    EUC_Ex3.kmz
21. Save the map that is displayed as a jpg (Click File, Save, Save Image).
22. Turn on Possible Squatter Areas, which are *municipios* that are more than 15 miles from downtown Mexico City and that have a population density higher than predicted on the regression line calculated above.



23. Temporarily turn off the Municipio Population Density layer for better viewing of the aerial imagery. Zoom into each of the four communities, and see if you can find any evidence of squatter settlement development. Once you have zoomed down, turn off Possible Squatter Areas to further improve the viewing of imagery. Be aware in this exercise that the resolution at large scales for Mexico City might not be as good as the U.S. imagery in the Chapter 1 and Chapter 2 Google Earth exercises.
24. Further examine these densely populated areas by dragging the Street View icon onto the map. Blue street lines will appear on the map where street-level imagery is available.

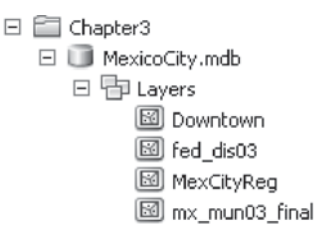


25. For a contrast to these impoverished squatter settlements, you will examine a wealthy area of Mexico City just inside the northwest border of the Federal District known as Bosque de Las Lomas ("Forest of the Hills" in Spanish). This area adjoins the upscale Polanco area, as well as being close to Chapultepec Park, where Los Pinos, the Mexican "White House," and many famous museums are located. In Search, type in "Chapultepec Park." The residential area of Polanco is to the northwest of the park and that of Las Lomas is to the west. Again turn off the Population Density and Possible Squatter Areas layers, and zoom in to examine the settlement pattern in this wealthy area. Also use the Street View imagery and turn on 3D buildings to see the community from street level. When you are finished examining this area, you can return to the Chapter 3 exercise and its layers by clicking the X button (Clear Searches) at the bottom of the Search pane in the Table of Contents.

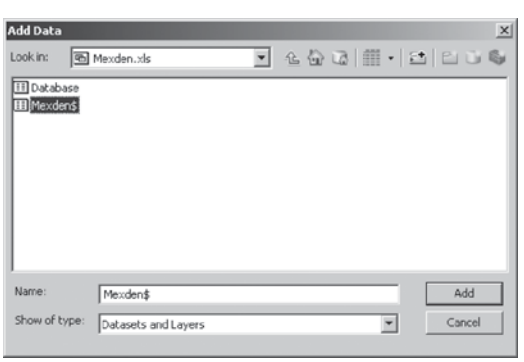
Google Earth Short Essay: Compare and contrast the settlement patterns you have observed for the squatter zones and the wealthy area. Consider differences in such elements as residential patterns, streets, green elements, prevalence of vehicles, and other contrasting elements you notice. Does this comparison give you any ideas about how the Mexico City government could plan and effect improvements for squatter neighborhoods?

ArcGIS 10 Version

1. Start ArcMap with a new empty map, and add mx_mun03_final under Layers in the MexicoCity geodatabase.



2. Add the Mexden spreadsheet you created earlier in the Google Earth section.



3. Right-click on mx_mun03_final, point to Joins and Relates, and click Join. Answer the following in the Join Data window:
   i. What do you want to join to this layer
      1. "Join attributes from a table"
   ii. Choose the field in this layer that the join will be based on
      1. "MUN_NAME"
   iii. Choose the table to join to this layer, or load the table from disk
      1. "Mexden$"
   iv. Choose the field in the table to base the join on
      1. "Mun_name"

   Click OK (if asked to create an index, answer yes).

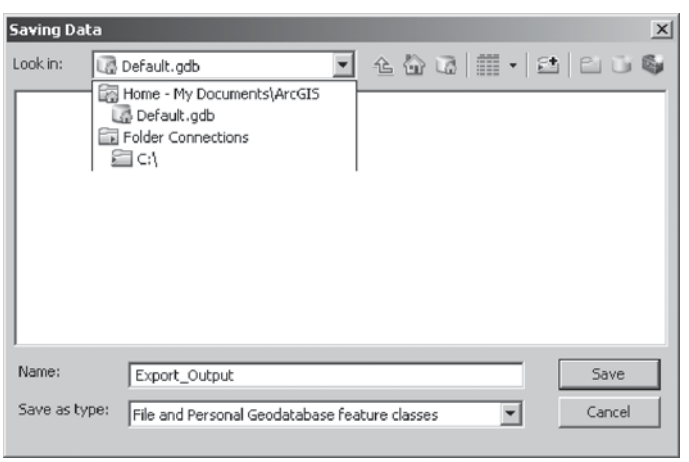
4. Click Selection and Select By Attributes, and enter the following query:

$$\$Mexden.Distance > 15 \text{ AND } \$Mexden.den00ln > 9$$

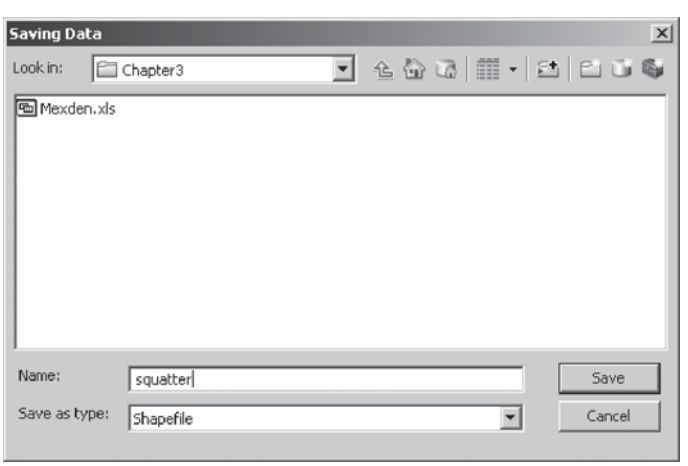
We chose this query by examining the graph and noting a cluster of outliers about 15 miles from downtown that had densities higher than the regression line (about a natural log of 9).

5. Add the Federal District Map (Fed_dist03.shp) layer to give some context. Make it a Hollow boundary and increase the line thickness.

6. Right-click mx_mun03_final, click Data, and then click Export Data. Click the folder button to change the Output Feature Class. Use the dropdown menu next to Look in: to specify where you want to save the data.

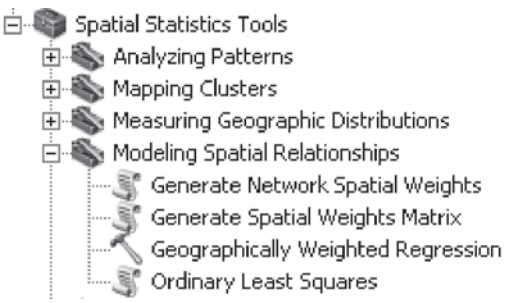


7. For the file type, use the dropdown menu to choose Shapefile. Name the new file Squatter.



8. On the screen, Click Yes to Add the layer to the Map. Click Selection and Clear Selected Features.
9. Compose a map using the Layout View that shows the *municipios* that are suspected of having squatter settlements due to their unusually high densities at relatively far distances from downtown.

Optional Method of Doing this ArcGIS Exercise if You Have the Geo-Statistical Analyst or ArcInfo: Compute the regression directly in ArcGIS with the Ordinary Least Squares tool found under the Spatial Statistics Tools set.



ArcGIS 10 Short Essay: Discuss the location of the high-density outliers relative to the model of Latin American city structure covered in the chapter. First, examine how dense these areas were in 2000 relative to the downtown. These settlements are low-rise, compared to the high-rises in the CBD. Discuss what you think this amount of density means from a living standpoint. Are these presumed "squatter" settlements located where the Latin American city model predicts they will be?

Log in to www.mygeoscienceplace.com for ArcGIS Exercise data files, Google Earth™ Exercise kmz files, RSS feeds, flashcards, web links, and self-study quizzes to enhance your study of the internal structure of cities.

CHAPTER

4 Systems of Cities

The urban systems approach to urban geography considers the interaction of cities within a larger system. Topics typically range from central place theory to the study of cities as nodes, with an emphasis on understanding the interaction among the nodes. Marshall (1989) described the importance of the approach as a reminder that a city is not isolated and without relationships to other cities in a system:

> Towns and cities are interdependent: any one town's size, economic character, and prospectus for growth are affected by the nature and strength of its interconnections with other towns. The events that occur in the development of an individual town cannot be understood fully without consideration of trends affecting the entire urban system. (pp. 10–11)

As in other systems research, it is important to emphasize the interdependencies of system components, as a change to one component could have consequences for the others.

Examples of such urban system responses can be drawn from multiple geographic scales. Consider, for instance, political and economic tensions in the early 21st century over global competition in steel imports and exports. Steel producers in U.S. cities like Gary, Indiana, and Pittsburgh, concerned about their domestic clients buying less-expensive steel from foreign producers, pressured the Bush administration to impose tariffs on steel imports from places like South Korea. Tariffs were imposed, but repealed a year and a half later. Clearly, actions taken by steel producers in cities worldwide have an impact on the economic well-being of their global counterparts. Another regional example of an urban system response was the 1970 slowdown in the steel industry, which resulted in the economic restructuring of places like Pittsburgh and Gary. However, the initial pain was felt all the way down the urban hierarchy in places like Hibbing, Minnesota, on the Iron Range. Hibbing's livelihood depended on steel producers on the opposite side of the Great Lakes purchasing its iron for steel manufacturing. A local example might be the obvious linkage between a medium city's vibrant new retail strip on its periphery and the declining shopping traffic experienced by retailers in the downtowns of its neighboring cities.

A global example relates to the steel boom of the early 2000s, stimulated by China's huge demand for iron ore (Restall, 2010). The three major iron ore producers in Australia—Rio Tinto, BHP Hilliton, and the Brazilian producer Vale—responded by increasing iron ore production, while trying to set their own benchmark pricing. Tensions increased when a deal for Aluminum Corporation of China to take a large stake in Rio Tinto fell through and negotiations on steel pricing with China's state-owned producers stalled in 2009. Subsequently, Rio Tinto executives in China were convicted and sentenced for bribery in Chinese court. Chinese private and state-owned steel firms might share some of the blame, the result of claims that they cut corners with regard to the law and exerted inappropriate political influence (Garnaut, 2010). These tensions have impacted not only Chinese steel firms and cities they operate in throughout China, but also cities hosting supplier firms in Australia and Brazil, as well as affecting broad national and international markets. It demonstrates how global market systems are tying global firms and their cities together in negative and positive interdependencies.

A study by Walcott and Wheeler (2001) of the Atlanta metropolitan area demonstrates the urban system approach by establishing the area as a significant telecommunications center, as measured by the use of fiber optics. The study finds that Atlanta ranks sixth in the total number of backbone connections with other metropolitan areas and that Atlanta's rank in the U.S. urban

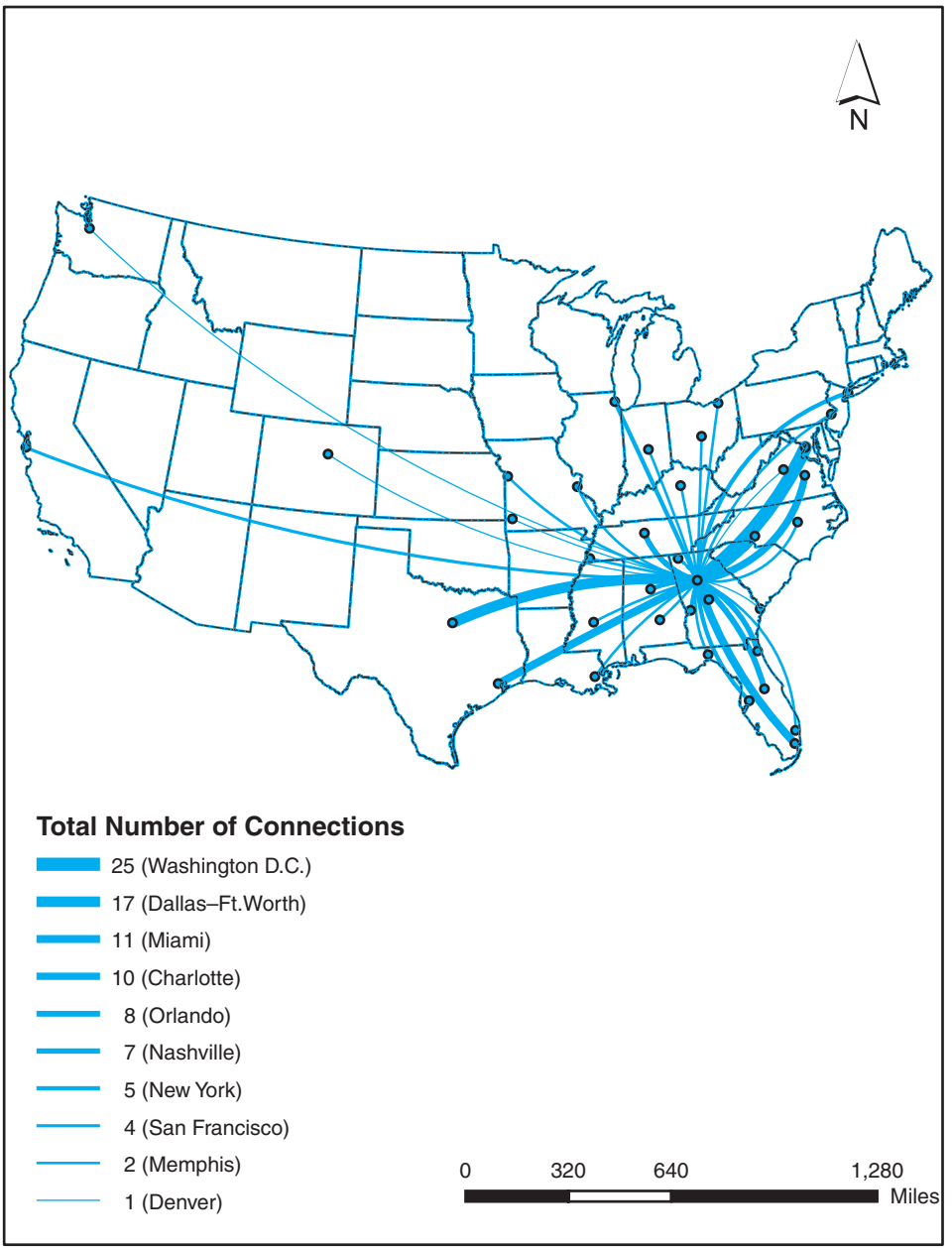


FIGURE 4.1 Atlanta's direct national Internet connections, 2000. *Source*: Walcott, Susan M. and James O. Wheeler. 2001. "Atlanta in the Telecommunications Age: the Fiber-optic Information Network." URBAN GEOGRAPHY 22(4):316–339. © Bellwether Publishing, Ltd. Reprinted by permission. Figure 1. P. 324. "Atlanta's direction national Internet connections, 2000."

hierarchy based on telecommunications is considerably higher than that based solely on population. Thus, Atlanta has been reordered within the national hierarchical system of cities, a phenomenon that is reflected in the spatial layout of fiber-optic linkages with other U.S. metropolitan areas (see Figure 4.1). The authors demonstrated that the strong presence of broadband access in both Atlanta's traditional downtown and its developing edge cities attracts new businesses seeking ready access to this backbone to interact with other metropolitan areas in the United States and around the globe. Oracle's headquarters presence in Redwood City, California, shown in Figure 4.2, is an example of a firm locating away from the central city in an area with excellent broadband access.

Malecki (2002) further demonstrated a global bias toward world cities in Internet backbone networks, with selected urban areas serving as interconnection points between the backbone networks. Here it is argued that the backbone networks, which ultimately define the outline of the Internet's infrastructure, reinforce the urban system. Nevertheless, Malecki also confirmed that in some cases the number of Internet connections did not correspond with the largest cities in terms of population. Both of these studies extend a long tradition in urban systems research of articulating underlying causes for hierarchical distributions of cities. The Internet is perhaps the latest technological influence and is sure to grow in importance throughout the 21st century.

FIGURE 4.2 Oracle's corporate headquarters in Redwood City, California.

This chapter begins with a review of central place theory, which is the most classic demonstration of the urban systems approach. *Central place theory* attempts to explain the location, size, and spacing of cities within an urban system. Although an old theory, it continues to provide the theoretical background for current-day applications in location analysis and retail-trade area analyses. When many of the rigid assumptions of the classic model are relaxed, it becomes a powerful analytical framework for understanding the complex landscapes of the service and retail economy. Originally, central place theory was applied at a regional scale to understand the relationship between central places and their surrounding hinterlands. Today, the theory is often applied at the scale of an individual metropolitan area, or it is utilized to examine consumer transactions occurring at the neighborhood scale all the way to the scale of consumers interacting with the large downtown.

The chapter then turns to an evolutionary model of the American urban system. The model emphasizes technological innovations as the principal force for differentiating the urban hierarchy, with each innovation resulting in a new epoch of city building and shifting locational advantages. Prior to the development of the railroad, the large ports in the eastern United States benefited from their position on the Atlantic and Gulf Coasts. As the railroads were built, the port cities continued to grow, but new opportunities opened up in the interior of the United States. When the automobile first came on the scene, urban settlement had already spread across the country, but this new transport technology and its associated highway network allowed for development that was less tied to traditional resource bases and more driven by amenities such as warmer climates.

The chapter concludes with a discussion of global cities, with an emphasis on the concern over the concentration of financial power in a few large cities within a global network of cities. New York, London, and Tokyo are of particular interest, as they were prominent in finance to begin with, but became even more financially specialized as their manufacturing base receded. Urban scholars have become increasingly interested in examining social and economic dislocation resulting from the concentration of financial resources in a few large cities. Johannesburg demonstrates that a prominent African metropolis can experience a rough path to becoming global and is beset by problems. India's global cities have led in technology and entertainment, but lag in infrastructure and city services.

4.1 CENTRAL PLACE THEORY

In central place theory, the role of the city is that of a provider of services to a surrounding hinterland population. Therefore, the theory is concerned with understanding the spatial arrangement of economic activities and the consuming population of a surrounding market area. We can then characterize

the city for purposes of this theory in two ways: (1) as the focus of a hinterland and (2) as the supplier of goods and services to the hinterland. Over time, the theory has been recast in practical terms as relating to goods provided by the city's retail and services sectors to its local market area.

Walter Christaller (1933), a German geographer who worked to explain the size, spacing, and location of cities, is credited as the founder of central place theory. Christaller first tested his theoretical constructs in the 1930s, using southern Germany as an example. He developed many theoretical concepts, one of which was *central place,* defined as a place that has developed to provide goods and services to a surrounding hinterland population. This definition would be consistent with most of the larger places in southern Germany in the 1930s, but would exclude towns that did not exist solely to serve a surrounding hinterland population. So for the purposes of his theory, Christaller considered only certain functions of the city and explicitly ignored most manufacturing, along with resorts and other such developments that did not necessarily fit with the theory. *Centrality,* a concept developed to define central place importance, was not necessarily correlated with the population size of a place because, as Christaller noted, a large population did not always signify importance. Rather, Christaller used the number of telephone connections as a surrogate for centrality, as most business communication was by way of phones at that time. Perhaps today an important measure of centrality might be the number of broadband Internet connections of a place, especially given that population size does not always predict the number of such connections (Malecki, 2002; Walcott & Wheeler, 2001).

Another important central place concept is *threshold,* which refers to the amount of purchasing power required in the region to support a person engaged in a business activity. Threshold can also be interpreted as the minimum amount of sales necessary for an entrepreneur to break even on a business investment. On the basis of threshold level, the theory distinguishes between two types of goods, *low-order goods* and *high-order goods*. Low-order goods are purchased by a consumer frequently and replenished by an entrepreneur regularly. High-order goods, on the other hand, are purchased by consumers less frequently, and businesses that provide such goods count on a large consumer population from which to draw to offset the lack of frequent patronage by single customers. Thus, because of the hierarchical nature of goods and services, their market sizes are also hierarchical. For instance, because consumers purchase low-order goods and services frequently, entrepreneurs need only a small market size to attain the necessary economies of scale to break even. High-order goods and services, on the other hand, require a larger market size to attain a critical mass of consumers and break even.

The theory also specifies the *range* of a good or outer limit of the market area, which is defined as the maximum distance consumers are willing to travel to purchase the good or service before they decide to do without. The range of a good is said to be the spatial corollary of a threshold because it is the area required for a business to stay viable. Three types of ranges were identified by the theory. The first was referred to as the *inner range* of a good, or the spatial extent of the hinterland necessary for a business to stay viable. If consumers were evenly distributed around an offered good or service, the inner range would be circular and would extend outward from the good until it reached the threshold purchasing power necessary for the business to continue offering the good or service.

The *ideal outer range* of a good is the maximum spatial extent of the trade area defined by the distance consumers are willing to travel to purchase the good or service. The ideal outer range is thus typically larger than the inner range of a good, as it would include a greater area and thus more consumers than the minimum necessary for the entrepreneur to stay in business. In the absence of competition, an ideal outer range extending well beyond the inner range would result in large profits for the business.

The *real outer range* of a good is the actual extent of the market area given that there is competition between central places to attract customers. Berry and Parr (1988) provided actual distances for the real outer ranges of selected goods and illustrated how they varied according to the level of the place (hamlet, village, town, or city) from which they were purchased. Level was measured by the number of central functions (see Figure 4.3):

> Thus, the real range of food stores is just over 5 miles for villages but about 10 miles for towns. Similarly, the real range of clothing stores is just over 10 miles for towns but well over 20 miles for cities. The diagonal line . . . represents an "envelope" curve that traces out variations in the real range (the maximum distances traveled to centers) for different levels of the hierarchy. (Berry & Parr, 1988, p. 26)

Rational economic assumptions about entrepreneurs and consumers dictate that the ideal range will not exist, or at least will not exist for long, as entrepreneurs with full information on the central place landscape and surrounding hinterlands will be quick to offer goods and services to the areas yielding excess profit.

The outcome of this theory for city systems is that there will always be many more smaller cities in a given landscape than there will be large cities because the higher-order goods and services offered by large cities require a large hinterland. As a result, there will be a logical hierarchy that emerges (i.e., hamlet, village, town, and city), with substantial distance between larger cities and very little distance between smaller places. At the same time that larger central places offer high-order goods and services, they will also offer low-order goods and services for a smaller area, resulting in a nested structure of market areas.

Many practical applications have been developed from the formal theory. In particular, the urban retail landscape appears to mirror a central place hierarchy. Berry and Parr (1988) noted a strong relationship between regional hierarchies of market centers and those of urban centers, although in the latter case there was more complexity. As seen in Figure 4.4, the typology of business areas within metropolitan areas recognized three types of concentrations: (1) a set of nested hierarchical centers (i.e., central business district [CBD], regional center, community

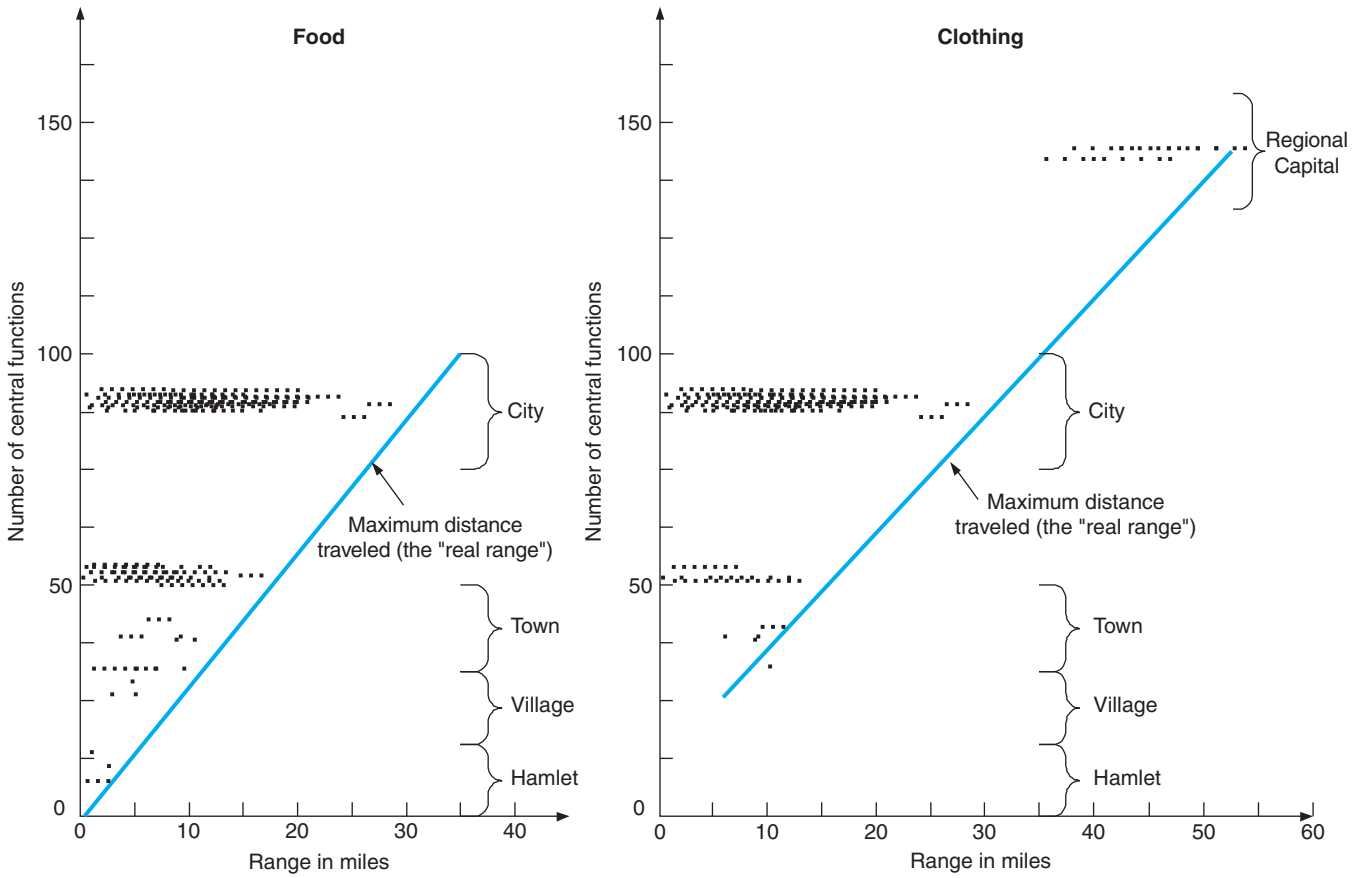


FIGURE 4.3 Examples of range of a good. *Source*: Berry & Smith. MARKET CENTERS AND RETAIL LOCATION: THEORY & APPLICATION, 1st, © 1988. Printed and Electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, New Jersey. Figure 2.3. Page 26. "The Real Ranges of Food and Clothing at Different Levels of the Hierarchy."

center, neighborhood center, and convenience center) that is similar to the nesting articulated for market centers from central place theory (i.e., town, village, and hamlet); (2) commercial ribbons that are composed of shops, restaurants, service stations, and motels; and (3) specialized functional areas of similar businesses that are held together by close linkages provided by comparative shopping. For Chicago, they noted that the size, spacing, and location of these agglomerations were dictated by the same central place principles governing the rural hierarchy of hamlets, villages, towns, and cities.

A decade later Borchert (1998) demonstrated that Berry's urban classification of shopping centers' business configurations

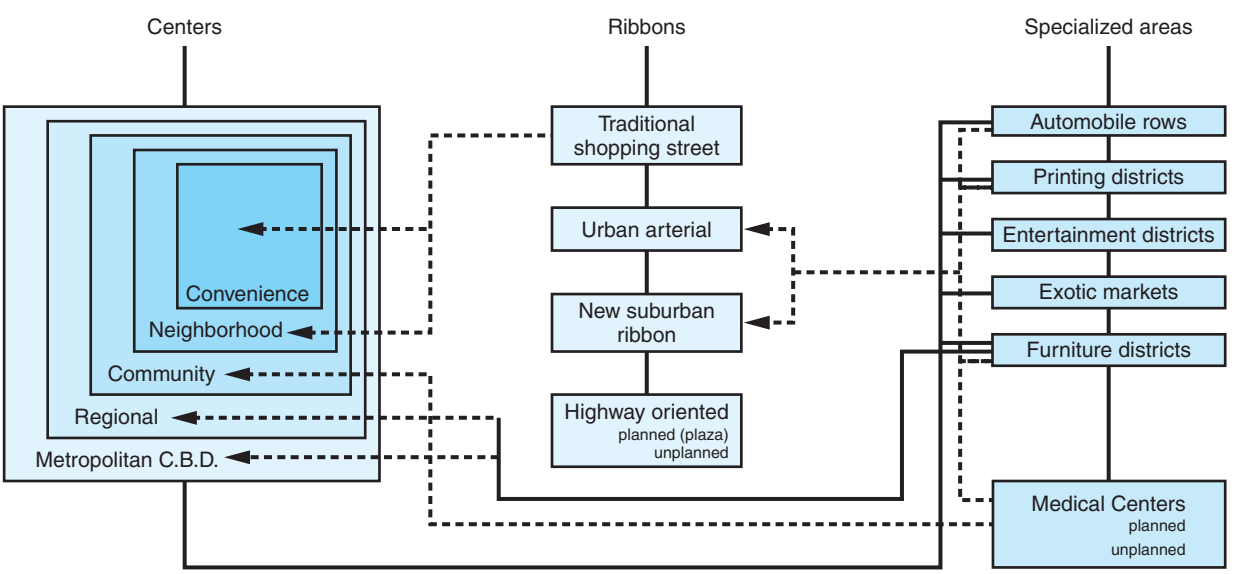


FIGURE 4.4 Typology of business areas within a metropolitan area. *Source*: Berry & Smith. MARKET CENTERS AND RETAIL LOCATION: THEORY & APPLICATION, 1st, © 1988. Printed and Electronically Reproduced by permission of Pearson Education, Inc., Upper Saddle River, New Jersey. Figure 2.16. Page 39 "Typology of Business Areas with in a Metropolitan Region."

still adequately described contemporary retail landscapes. Borchert (1998) used the results of the study to refute recent claims that the classical hierarchy of shopping centers was diminished in light of newer retail configurations:

> [T]he basic principle formulated by Christaller is applicable as before: goods and services with a high frequency of consumption can be distributed from a denser network of locations than those responding to less frequent needs. Of course threshold values and the range of goods are changing continuously, but this in no way injures the value of the theory. Actually, Christaller was well aware of the changeability of these variables, which makes the central place theory suitable in dynamic situations. There is no reason why a concept such as threshold should be limited to traditional types of retailing and not extended to innovative forms of retailing. (p. 332)

In addition to explaining the geography of retail, central place theory has been applied to study a wide range of other goods and services. For instance, Blau (1989) studied contemporary cultural patterns in the United States and demonstrated that central place theory helped account for some of the variation in the consumption of both high culture and popular culture from place to place. At the regional scale or at the top of the hierarchy, the theory helps account for why we have a West Coast concentration in the production of films and an East Coast concentration of large cities with a focus on high culture such as opera, dance, and theater. Moreover, Blau (1989) contended that central place theory helps explain why very large places support esoteric and very expensive cultural activities, whereas cultural activities that are in high demand and relatively inexpensive can be found in places of all sizes.

Although many researchers continue to find much explanatory power in central place theory, others find it limiting. Key among the criticisms of central place theory are the economic and landscape assumptions on which the initial theory was based. The economic assumption that consumers are rational is not unique to central place theory, but is well developed in neoclassical economics, where it has also received much criticism. Christaller's simplistic landscape assumptions were necessary for him to model uniform travel of consumers to central places, yet it is this aspect of the theory that has received much criticism. Dennis, Marshland, and Cockett (2002) summarized some of these concerns and proposed methods for relaxing some of the strict assumptions of Christaller's classical theory for interpreting contemporary retail landscapes.

In the next section, we re-create one of the classic central place studies from the 1950s on Snohomish County, which highlights some of the strong empirical evidence in support of the theory. At the same time, the analysis points out deviations from the theory and possible explanations for such statistical outliers. The current-day central place landscape of Snohomish County is presented and compared to the earlier 1950 hierarchy. Methodological issues and expected findings are addressed for a proposed replication of the 1950 study.

4.2 THE CENTRAL PLACES HIERARCHY IN SNOHOMISH COUNTY, WASHINGTON

Berry and Garrison (1958) selected Snohomish County in the state of Washington to search for evidence of a hierarchy of central places in a system of urban centers. Snohomish County was ideal for this type of study in the 1950s because it had a large number of centers that ranged from very small (hamlets) to medium size (villages and towns) and only one very large city, Everett, which was excluded from the study. As shown earlier, the hierarchical system of hamlets, villages, towns, and cities is an important aspect of central place theory. That is, the model argues that places will belong to one of these types. Each type of place is characterized by a certain population limit and has a certain level of central place functions that are associated with this given population size (see Table 4.1). For instance, the population threshold of 196 for filling stations could be interpreted to mean that filling stations, at least in the case of Snohomish County in the 1950s, required a market area encompassing 196 persons. By analyzing a variety of urban functions ranging from low-order goods and services (e.g., filling stations) to high-order goods and services (e.g., health practitioners), Berry and Garrison were able to classify places into three types.

A geographic information system (GIS) project was designed to replicate the county's central place landscape of the 1950s (see Figure 4.5 on page 113). The GIS database was designed to include all 33 places from the original study, as well as the critical attributes of the analysis. For instance, Figure 4.5 highlights the attribute table entry for the central place of Darrington. The TYPE field indicates a value of 2 for Darrington, which would identify it as a village-level central place. The ACTIVITIES field indicates that Darrington had a total of 25 functions identified for it in the 1950s, and the A1 field is the code for filling stations, showing that Darrington had three filling stations at the time. Table 4.1 gives the codes for functions at the hamlet, village, and town levels. The transportation GIS layer in the figure is contemporary and reflects a much more mature network than that of the 1950s; thus, it is used only for context and is not incorporated in the analysis.

The GIS design has allowed for the validation of a number of central place principles. First, the visual display of the three levels of the central place hierarchy provides immediate evidence of the principle that there are more small central places in a central place landscape than there are large ones. For instance, with the cartographic technique of graduated symbols it is easy to identify 20 hamlets, 9 villages, and 4 towns in the county. The cartographic display also allows for the immediate visualization of some of the spacing principles of central place theory; for example, it is easy to see that the spacing between hamlets is more equal with respect to other hamlets than it is with respect to the spacing between hamlets and villages or towns. The distance between the four towns is close to equal. Although not computed for this study, distance measures could be computed directly within the GIS to quantify the variability in these distances.

Each of the three types of central places (hamlets, villages, and towns) identified by Berry and Garrison contained specific groups of central functions and were characterized by a certain

TABLE 4.1 Population Thresholds Established by Central Place Function from Original Snohomish County Analysis

GIS Code	Activity	Population Threshold	GIS Code	Activity	Population Threshold
(a) Hamlet-Level Functions					
A1	Filling Stations	196	A4	Restaurants	276
A2	Food Stores	254	A5	Taverns	282
A3	Churches	265	A6	Elementary Schools	322
(b) Village-Level Functions					
B1	Physicians	380	B20	Variety Stores	549
B2	Real Estate Agencies	384	B21	Freight Lines and Storage	567
B3	Appliance Stores	385	B22	Veterinaries	579
B4	Barber Shops	386	B23	Apparel Stores	590
B5	Auto Dealers	398	B24	Lumberyards	598
B6	Insurance Agencies	409	B25	Banks	610
B7	Bulk Oil Distributors	419	B26	Farm Implement Dealers	650
B8	Dentists	426	B27	Electric Repair Shops	693
B9	Motels	430	B28	Florists	729
B10	Hardware Stores	431	B29	High Schools	732
B11	Auto Repair Shops	435	B30	Dry Cleaners	754
B12	Fuel Dealers	453	B31	Local Taxi Services	762
B13	Drug Stores	458	B32	Billiard Halls and Bowling	789
B14	Beauticians	480	B33	Jewelry Stores	827
B15	Auto Parts Dealers	488	B34	Hotels	846
B16	Meeting Halls	525	B35	Shoe Repair Shops	896
B17	Animal Feed Stores	526	B36	Sporting Goods Stores	928
B18	Lawyers	528	B37	Frozen Food Lockers	938
B19	Furniture Stores	546			
(c) Town-Level Functions					
C1	Sheet Metal Works	1076	C6	Photographers	1243
C2	Department Stores	1083	C7	Public Accountants	1300
C3	Optometrists	1140	C8	Laundries and Laundromats	1307
C4	Hospitals and Clinics	1159			
C5	Undertakers	1214	C9	Health Practitioners	1424

Source: Berry, B. J. L., and Garrison, W. I. (1958). "The functional bases of the central-place hierarchy." *Economic Geography* 34(2):150. Table 2, "The functional bases of classes of central places in Snohomish County: variates."

population size. Towns contained all of the low-order central functions (e.g., filling stations, food stores, and churches) of the hamlets and villages plus high-order functions (e.g., photographers, public accountants, and health practitioners) not found in hamlets and villages. Population size was highly correlated with the level of central place functions offered by places, reflecting the threshold concept of central place theory, which states, for example, that a large threshold of population is necessary before a high-order good or service will be offered.

This latter central place principle of thresholds of goods and services was tested within the GIS with several database queries. For instance, Table 4.1 indicates that hardware stores are functions that would be offered by village- and town-level central places, but would probably not be offered by hamlets. GIS analysis shows that only 1 hamlet (Lake Stevens) out of 20 had a hardware store. Thus, with the exception of Lake Stevens, the threshold concept appears to have been quite valid for this landscape in the 1950s. On closer inspection, Lake Stevens had a population size much more in common with a town-level place, but Berry and Garrison classified it as a hamlet because it was underrepresented by high-order central functions (see Figure 4.6). At least in terms of hardware stores, the GIS query shows that Lake Stevens does seem to fit the character of a town-level place, rather than a hamlet-level place.

In the original study, Berry and Garrison discussed both Lake Stevens and Edmonds with respect to being underrepresented with central place functions given their population sizes. This was tested and confirmed with GIS queries. One explanation given by Berry and Garrison for the divergence of central place functions in Lake Stevens and Edmonds (along with

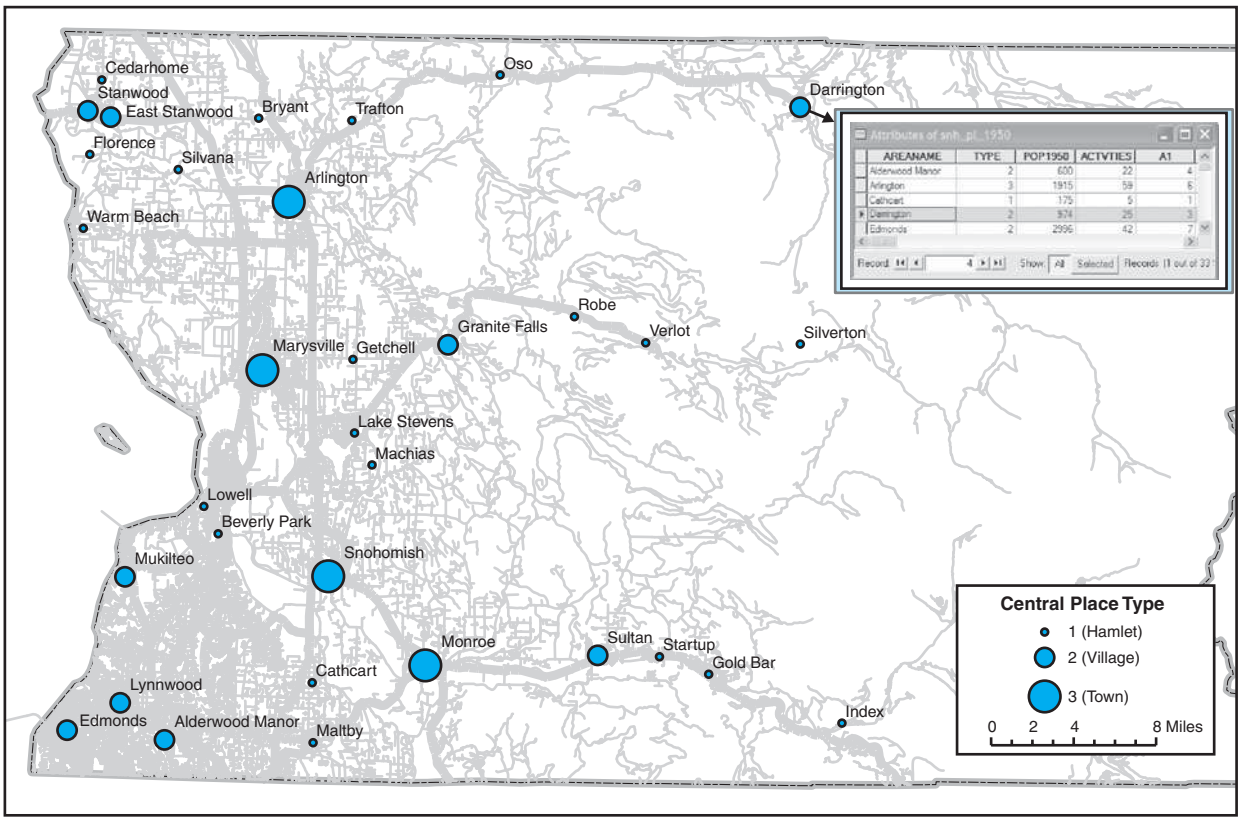


FIGURE 4.5 Snohomish County central place hierarchy in the 1950s, with year 2000 road network.

Beverly Park and Lowell) from their expected function groupings was that they each had experienced rapid population growth at the time (pressure from greater Seattle) and there is usually a lag in service delivery in such cases. In other words, it was expected that these places would gain more high-order central place functions as time passed, especially as entrepreneurs recognized their population sizes and began to offer the appropriate goods and services associated with those thresholds.

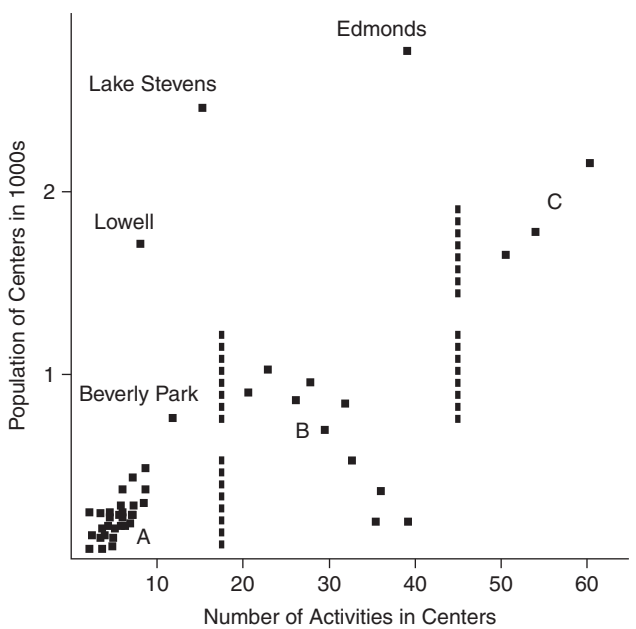


FIGURE 4.6 Population centers (in 1000s of population) versus number of activities in centers. *Source*: Berry, Brian J.L. and William I. Garrison. 1958. "The Functional Bases of the Central-Place Hierarchy." ECONOMIC GEOGRAPHY 34:145–154. Reproduced with permission of Blackwell Publishing Ltd. Figure 2. "Classes of central places in Snohomish County."

To illustrate how the central place landscape of Snohomish County has changed since the 1950s, a GIS layer of places in 2000 was created (see Figure 4.7). The creation of the layer also involved some GIS overlay techniques and relational table joins to determine which places are no longer present, as well as which new central places have arisen since the 1950s. The first overlay technique identified places that are no longer present in Snohomish County. These places have been absorbed by other places since the 1950s and are thus not part of the contemporary central place landscape. To determine the places that are new since the 1950s, a relational join was conducted that joined the new 2000 GIS layer with the earlier 1950 GIS layer. A *relational join* in a GIS refers to combining two tables into a single table on the basis of a common characteristic shared by both tables. This technique determined that 35 places had been added and that 23 places had persisted since the 1950s.

The GIS activity of updating the central place landscape of Snohomish County from the 1950s to 2000 revealed a much more complex urban system. Snohomish County today is much more integrated with the Seattle metropolitan area, and many of the older places have coalesced into each other, making it difficult to assign activities to a given center. Similar to the case study of the Chicago area's central place hierarchy by Berry and Parr (1988), consideration might be given to reexamining Snohomish County in terms of its metropolitan

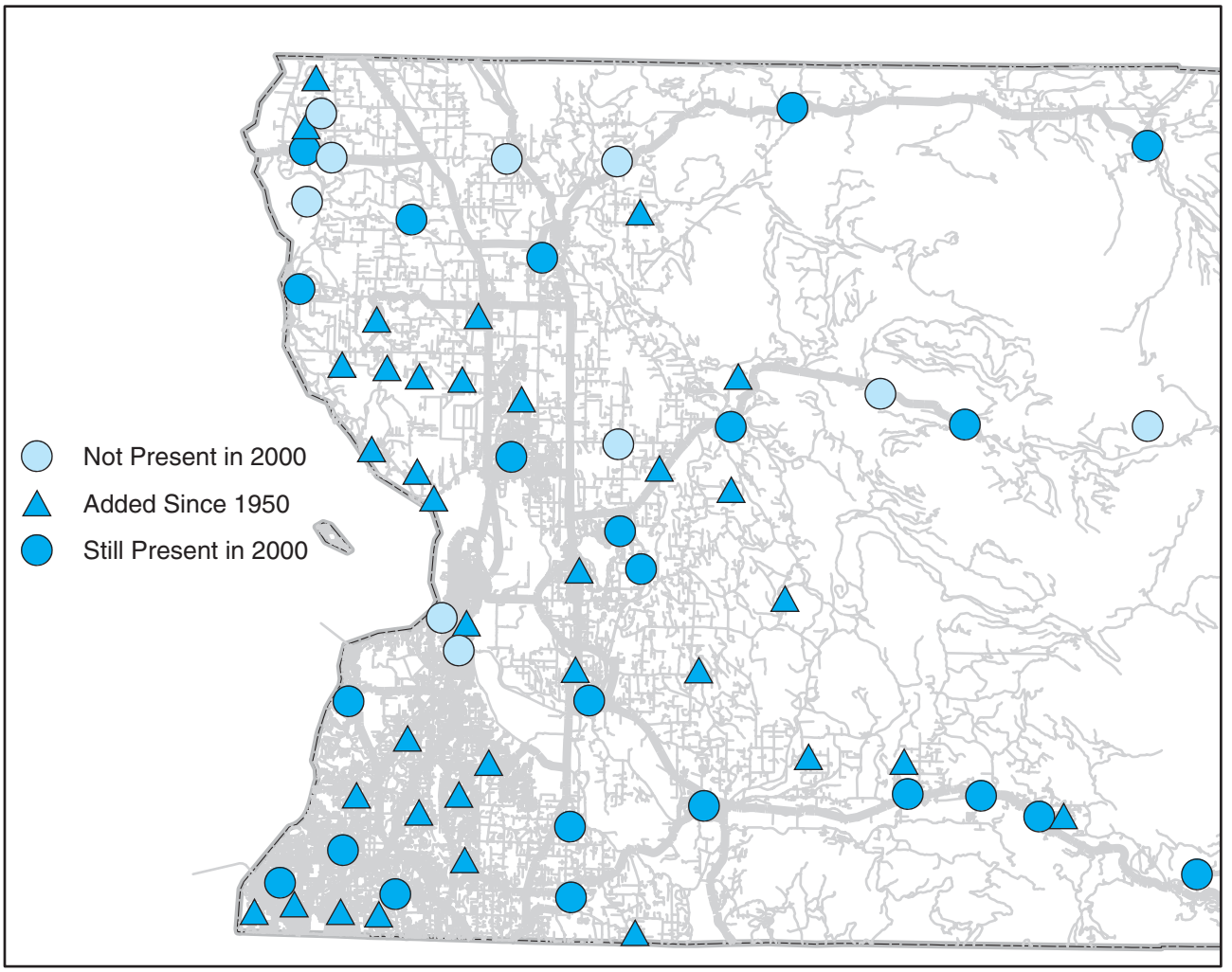


FIGURE 4.7 Changes between 1950 and 2000 in the central place landscape of Snohomish County.

context. In a metropolitan context, functions would be grouped into a hierarchy of business centers, highway-oriented ribbons, urban arterial commercial developments, and specialized functional areas. Today, such a study could take advantage of online yellow pages and reduce the amount of data entry time that presumably was required in the 1950s study. On the other hand, many of the earlier central places have grown to the point of being much larger than town size, and the explosion of categories of economic functions, as well as the disappearance of certain functions, might make updating the earlier study a challenging project.

4.3 CONTEMPORARY CENTRAL PLACE RESEARCH AND THE GRAVITY MODEL

The gravity model has been applied to the study of central place theory in general and to retail location analysis more specifically. Reilly (1931) was one of the first to apply the gravity concept of physics to the study of retail trade and human interaction among central places. Reilly's formulation is an extension of Ravenstein's (1885) application of the gravity model to migration studies, which is reviewed in more detail in Chapter 6. The general gravity model holds that any two bodies attract each other with a force proportional to the product of their masses and inversely proportional to the square of the distance between them. Reilly then interpreted this for retail as meaning that two cities would attract consumers from some smaller, intermediate cities in direct proportion to their population sizes and in inverse proportion to the square of their distances from the intermediate city. Reilly later went on to develop a technique, now referred to as *Reilly's law of retail gravitation,* that allowed one to determine trade area boundaries around cities based solely on population and distance measures.

Huff (1964) offered an alternative model referred to as the probabilistic model of consumer spatial behavior. Huff and Black (1997) have since revisited his earlier formulation and emphasized that the model is rooted in central place theory:

> The close parallel between the probability model and the central place theory provides a much richer theoretical focus. An attempt to achieve the objective of the central place theory, that is, to derive the optimal size, number, and arrangement of centers to serve a dispersed population, can be made under real-world conditions with the use of the probability model. There are a number of concepts in the central place theory that could be

> analyzed empirically. The findings from such studies could, in turn, be utilized in a way to enhance the predictive capabilities of the model. (p. 91)

Huff's model results are often depicted as probability contours; for instance, a person from the Lincoln Park neighborhood in Chicago might have a probability of 0.9 of going to a nearby coffee house, whereas a person from Little Italy would have a probability of 0.2 of going to the same coffee house. The person from Lincoln Park would also be assigned a probability of visiting competing destinations, including ones in Little Italy.

Huff first formulated his ideas by establishing an attraction index to be associated with a given retail facility:

$$v(j) = A_j^{\gamma} D_{ij}^{-\lambda}$$

where A_j is an attraction index associated with a particular retail facility j, D_{ij} is the accessibility of a retail facility j to a consumer located at i, and A^{γ} and D^{λ} are empirically derived parameters. The quotient derived by dividing A_j^{γ} by D_{ij}^{λ} is regarded as the perceived utility of retail facility j by a consumer located at i (Huff & Black, 1997, p. 84). The contours of the probability that a consumer located at i will choose to shop at retail facility j are determined as follows:

$$P_{ij} = \frac{A_j^{\gamma} D_{ij}^{-\lambda}}{\sum_{j=1}^{n} A_j^{\gamma} D_{ij}^{-\lambda}}$$

Today, this probabilistic model of consumer spatial behavior appears in many commercial GIS software packages. If it is not available, it is feasible to employ it directly in a standard GIS system, as distance calculations are derived easily with x and y coordinates. To illustrate the latter, consider the application of Huff's probability model for estimating the attendance at three major opera houses in the Chicago, Milwaukee, and Madison metropolitan triangle region (see Figure 4.8). The seating capacities of the three principal opera houses within the region were used as the attraction index: the Lyric in Chicago with 3,563 seats, the Skylight in Milwaukee with 358 seats, and the Oscar Mayer in Madison with 2,200 seats. Census tract centroids (internal x,y coordinate pairs) were used for the origins of those persons attending the opera. In the final computations, each tract was assigned three probability values, one for each opera house its residents were likely to attend (Figure 4.8). As shown on the map, the 50 percent draw for Chicago is much larger than the draws of its two competing opera houses.

4.4 CITY SIZE DISTRIBUTIONS

A substantial literature has developed on the topic of city size distributions, which addresses the question of how urban populations of a country are distributed across cities of varying sizes. In Chapter 2, the case of a *primate city* was discussed, which is reflective of a type of city size distribution where one city of a country dominates its urban hierarchy. A very common city size distribution, however, is the *rank-size distribution,* represented by the following equation:

$$P_r = P_l r^{-q}$$

where P_r is the population of the city ranked r, P_l is the population of the largest city, r is the rank, and q is an exponent. In demonstrating the practical use of this equation, Cadwallader (1996) assumed that $q = 1$ and rewrote the equation as

$$P_r = \frac{P_l}{r}$$

Using the latter equation, Cadwallader (1996) considered a hypothetical country where there are five cities and the largest of these has a population of 100,000 (see Figure 4.9 on page 117). Given that the rank-size distribution has an exponent of 1, the second largest city will have a population of 50,000 (100,000 divided by 2), the third city will be 33,333, and so on. As shown in Figure 4.9, city size distributions for the hypothetical country are plotted on a graph in which rank is on the horizontal axis and population size is on the vertical axis, illustrating a curvilinear form for the rank-size distribution. By varying the r values, the rank-size distributions have been shown to fit the United States and a large number of other countries.

4.5 EVOLUTION OF THE AMERICAN URBAN SYSTEM

Borchert (1967) presented an urban historical study on the evolution of the American urban system that revealed technological innovations as the major motive for changing hierarchies over time. He observed that the infrastructures of individual metropolitan areas, accumulated through various historical epochs, were distinguished from each other by different technologies. Borchert defined these epochs by identifying critical dates or transitions on growth curves of selected technologies of transport and industrial energy (see Figure 4.10 on page 117). These curves represented the following:

1. Rail mileage
2. General cargo tonnage on inland waterways
3. Production and use of primary energy from
   - **a.** Water power
   - **b.** Coal and oil
   - **c.** Motor vehicles
   - **d.** Highway mileage

The critical dates and epochs were then labeled as follows:

1. Sail–Wagon (1790–1830)
2. Steamboat and Iron Horse (1830–1870)
3. Steel Rail (1870–1920)
4. Auto–Air–Amenity (1920–)

According to Borchert (1967), major innovations in transportation and energy were influential in the location of growth within the national urban system, as well as within individual metropolitan areas. He emphasized that the

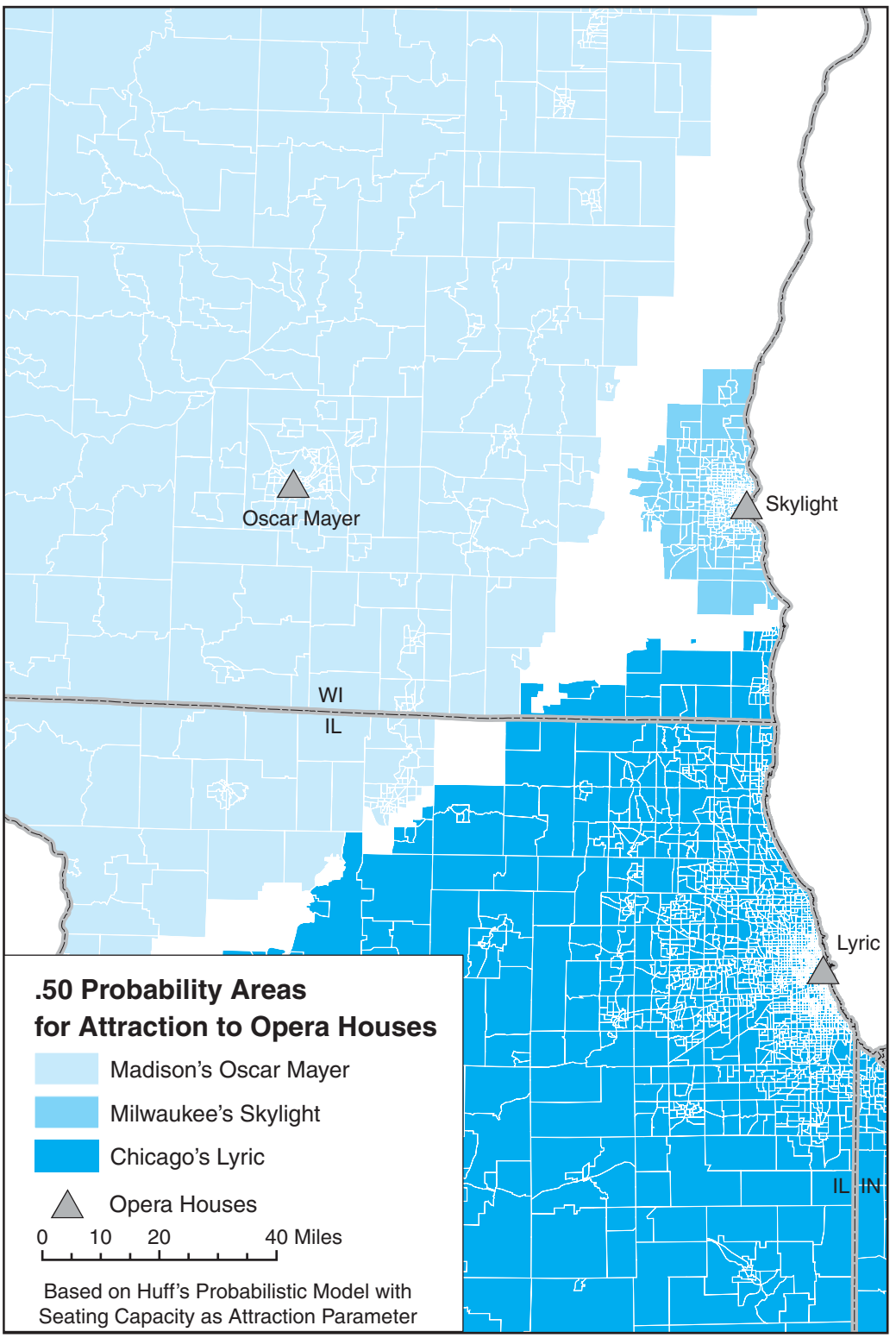


FIGURE 4.8 Huff's probabilistic model applied to Chicago, Milwaukee, and Madison opera houses.

boundaries between the epochs are not sharp, but rather are complex, and that there were minor epochs embedded, such as a canal epoch that Oliver (1956) and others observed from the 1810s to the 1840s.

The first major innovation identified was the steam engine in water and land transportation. The year 1830 was chosen as the beginning of this period because that date marked the buildup of steamboat tonnage on the Ohio–Mississippi–Missouri River system. The use of steam in railroad locomotives increased in significance and allowed for integration with water-transit systems, resulting in a national urban system biased toward ports with relatively large harbors.

The second major innovation was low-cost, mass-produced steel. The year chosen as the beginning of this phase

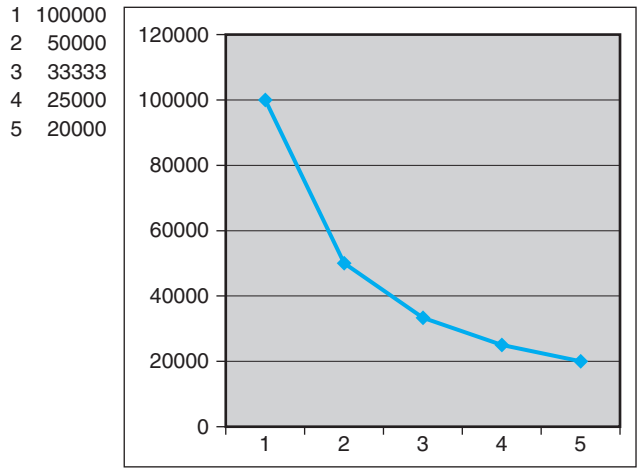


FIGURE 4.9 Rank-size distribution model. *Source*: Cadwallader, Martin. 1996. URBAN GEOGRAPHY: AN ANALYTICAL APPROACH,1st, © 1996. Printed and Electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, New Jersey. Fig. 12.5. P. 305.

was 1870, when steel rails were replacing iron on both existing and new rail lines. The cost of transporting coal was reduced, and as a result, central Appalachia's bituminous coal was extracted in large quantities and moved to the major port cities. Central-station electric power also began to expand. The railroads became the principal transporter of coal, and inland waterway traffic was diminished, resulting in the relative decline of many small river towns.

The third major innovation was the introduction of the internal combustion engine in transportation, and the beginning year chosen was 1920, when motor vehicle registrations became significant and petroleum production began its steep climb. Borchert (1967) argued that this innovation encouraged concentration of urban growth by putting the farmer in an automobile, but more important, it put the farmer on a tractor, which multiplied the land area worked. This sped up urbanization indirectly by increasing the size of the typical family farm. Borchert also stressed the simultaneous trend of the national economy away from primary and secondary employment toward service employment, which advantaged the cities with the highest concentrations of people. Thus, according to Borchert (1967):

> In the auto-air age, even more than in the preceding epoch, growth breeds growth. The second factor is the large and growing amount of leisure time available. As Ullman (1954) pointed out some years ago, this has led to the great importance of amenities as an urban location factor, both for commuting workers and for retired people. (p. 307)

Each of these major innovations led to changes in the physical layout of metropolitan areas in terms of density, location of economic activity, and land use patterns. Each one of these epochs is reviewed for its essential impacts.

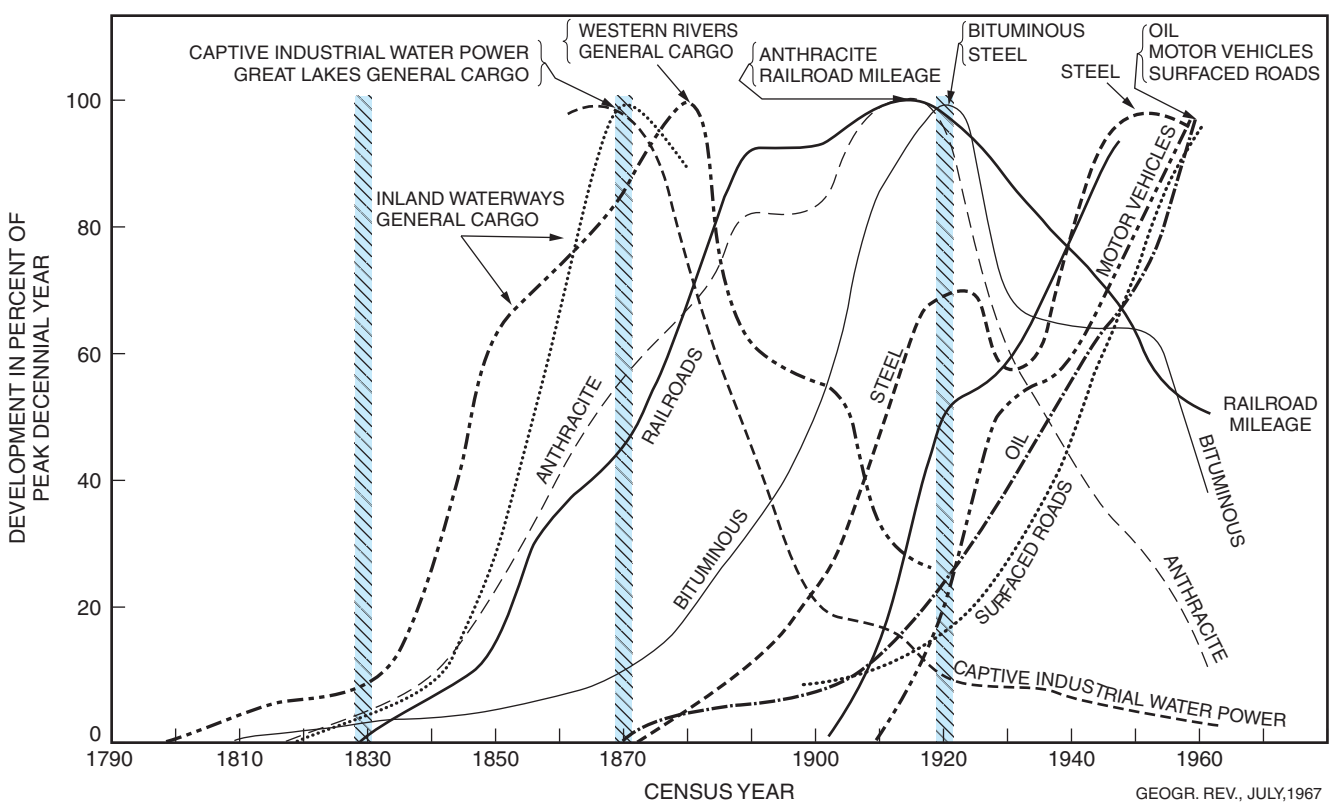


FIGURE 4.10 Borchert epochs in the evolution of the U.S. urban system, 1800 to 1960. *Source*: Borchert, John R. 1967. "American metropolitan evolution." GEOGRAPHICAL REVIEW 57:301–332. Reprinted by permission of American Geographical Society. Figure. P. 302. "The rise and decline of ten indicators of the technology of transportation and industrial energy."

4.5.1 Sail–Wagon Epoch, 1790 to 1830

The 1790 Census recognized only 22 urban places (Gibson, 1998), and most of them were port cities on the Atlantic coast or river towns that were linked to them (see Figure 4.11). Some of these early urban places were separate communities at the time of the 1790 Census, but have since become part of larger metropolitan areas. For instance, Salem, Marblehead, Gloucester, and Newburyport all have since become integrated into metropolitan Boston. Borchert (1967) noted that no one city dominated the nation at this point in time, as indicated by the almost equal populations of Boston, Philadelphia, and New York. The smaller inland river towns such as Richmond, Hartford, and Albany were all navigationally linked to the

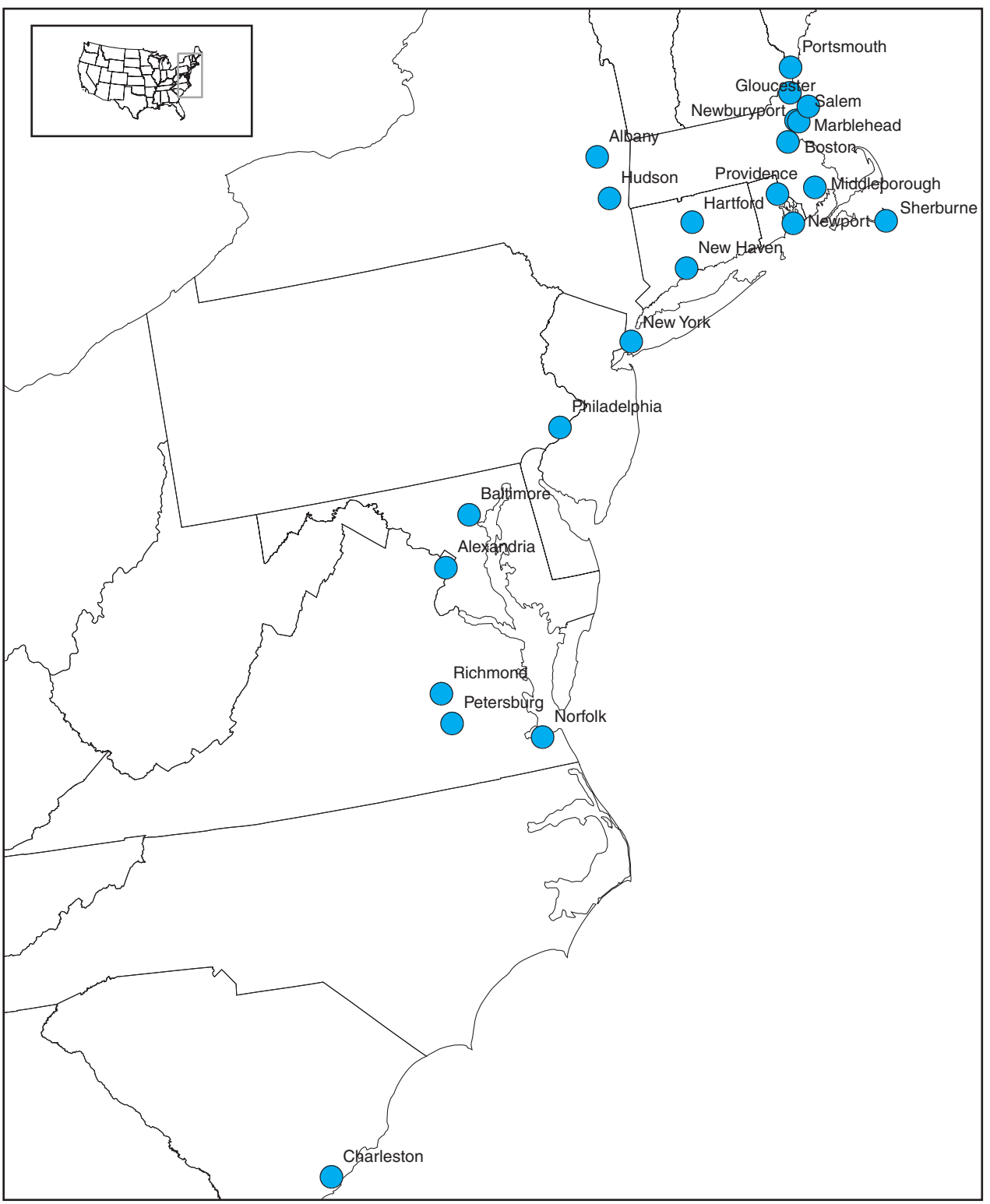


FIGURE 4.11 The 22 recognized urban places from the 1790 U.S. Census.

larger coastal cities, and their growth depended in large part on this relationship.

4.5.2 Steamboat and Iron Horse Epoch, 1830 to 1870

The 1830 Census recognized 90 urban places, and although coastal cities remained prominent, river cities located farther into America's interior were beginning to make their mark on the urban settlement system (see Figure 4.12). The largest urban places now extended all the way west to St. Louis on the middle Mississippi. Borchert attributed the growth in this period to the railroads, which were complementary to the waterways, as they were built inward from the major ports. Both were based on the steam engine. The development of the railroads accelerated the exploitation of coal, and as a result, places like Pittsburgh rose in the urban hierarchy. A very strong river

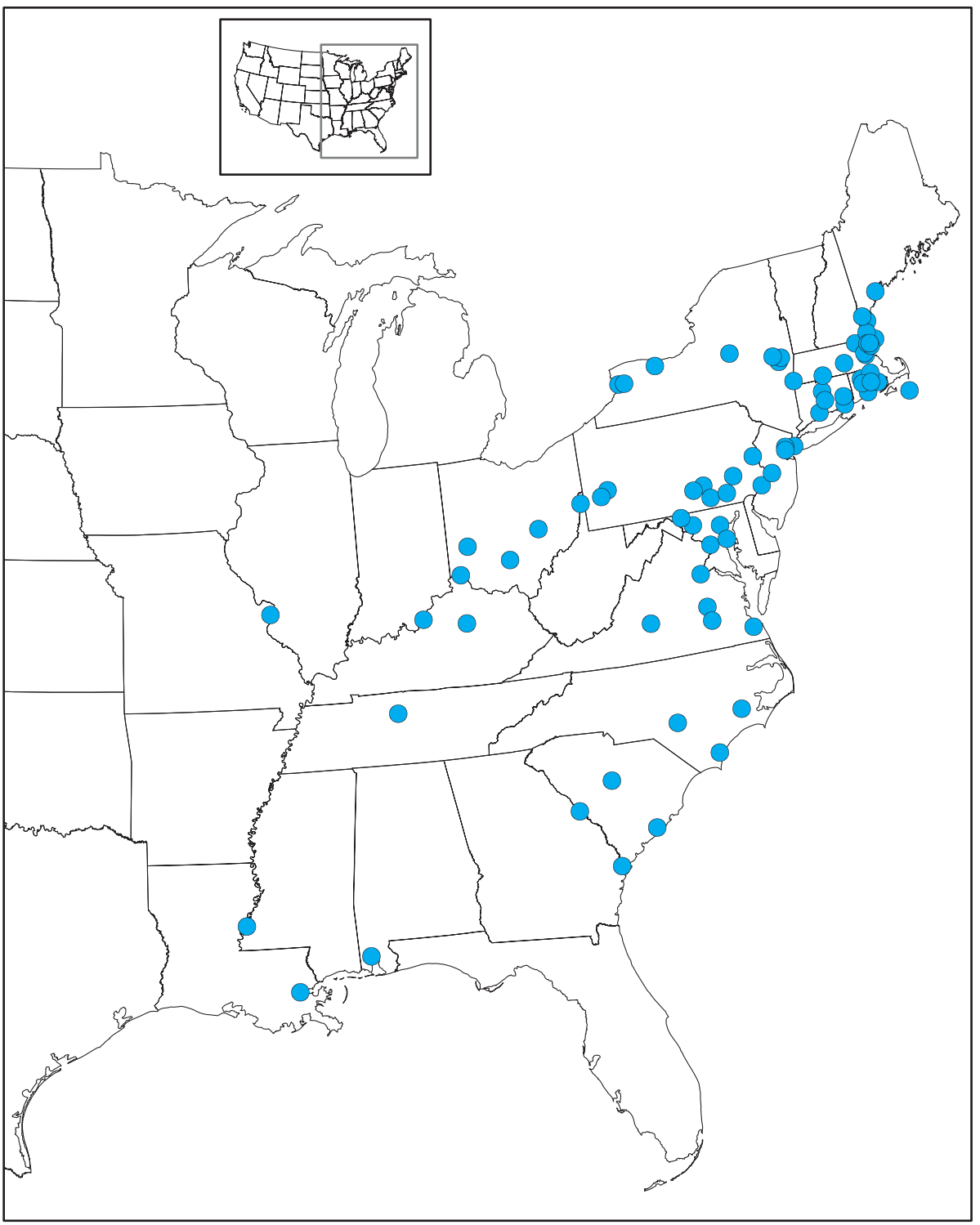


FIGURE 4.12 The 90 recognized urban places from the 1830 U.S. Census.

FIGURE 4.13 Cincinnati riverboat.

FIGURE 4.15 Milwaukee rail yards.

connection among top cities was becoming emphasized; for example, Cincinnati, Louisville, and Pittsburgh were all tied to the Ohio River system (see Figure 4.13). Following the Louisiana Purchase in 1803, New Orleans first appeared on the census list of the largest urban places in 1810, when it was listed in seventh position; by 1830, it had risen to fifth position, just below Boston. An inland waterway location or coastal position was still a very important factor for success in 1830, but when the railroads came, these railroad-linked cities were aided in reaching high positions in the urban hierarchy. New York's population had outdistanced the populations of both Philadelphia and Boston, principally because of a clear advantage with respect to access to the nation's hinterland by way of rivers, the Erie Canal, and then the railroads. The 1840 Census was the first to record at least 100 urban places with a population of at least 2,500.

4.5.3 Steel Rail Epoch, 1870 to 1920

In the 1870 Census, the 100 largest urban places reinforced the patterns established in the steamboat and iron horse epoch; however, the western limit of the American urban settlement system was considerably more expansive (see Figure 4.14). Added to the list of top urban places were Kansas City, Omaha, San Francisco, and Sacramento. Although added prior to 1870, the largest industrial newcomers to the urban hierarchy since 1830 were Chicago, Milwaukee, Cleveland, and Detroit (see Figure 4.15). According to Borchert (1967), growth resulted primarily from a nationwide system of rail lines, and the main industrial metropolitan centers of the Midwest and Northeast retained or advanced their position in the urban hierarchy on that basis. Places that dropped down the urban hierarchy, such as St. Louis and Louisville (although still within the top 100 largest places and still growing), fell because they were more central to the innovations of the steamboat and iron horse epoch than to those of the steel rail epoch.

4.5.4 Auto–Air–Amenity Epoch, 1920–

As Borchert (1967) published his original article in the late 1960s, he deliberately left the date off the end of the auto–air–amenity epoch because America was still in it. The largest 100 urban places in 1920 showed that since 1870 many new places had been added at the expense of others (see Figure 4.16). Borchert noted the declining significance of coal and railroad centers in the Appalachians and across the Midwest and their replacement by metropolitan areas located in the oil fields from central Kansas to western Texas

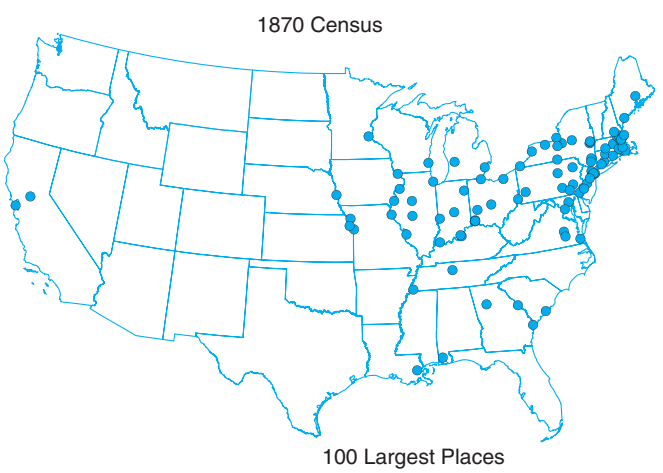


FIGURE 4.14 The 100 largest urban places recognized in the 1870 U.S. Census.

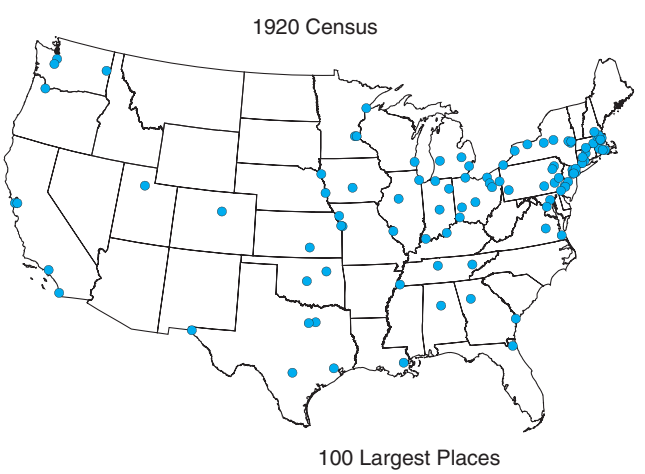


FIGURE 4.16 The 100 largest urban places recognized in the 1920 U.S. Census.

and the western Gulf Coast, as well as southern Michigan. The shift to the automobile and truck and a supporting highway network resulted in a more dispersed pattern of urban settlement. Borchert suggested that the influence was expressed in two ways:

> One is the entry into the metropolitan ranks of numerous "satellite" cities on the fringes of the historic Manufacturing Belt and within 100 to 150 miles of great metropolitan industrial centers. The other is the effect of suburban dispersal on the definition of a metropolitan area. In the Appalachians, for example, half a dozen "SMSAs" have dropped out because their central cities failed to maintain a population equal to, or larger than, that of other metropolitan centers. In these cases it is typical to find a central city crowded on a valley floor, blighted by obsolescent buildings, air pollution, narrow streets, and rusty rail lines, and exposed to flood risk. Population and commercial growth have dispersed to the uplands to exploit the resources of open space, a dense rural road network, panoramic views, and relatively clean air. The result is that the metropolitan area has grown and ceased to be "metropolitan" by definition, and the central city has declined and ceased to be "central" in fact. (p. 321)

The 1920 urban hierarchy inaugurated amenities as a major determinant in metropolitan growth, especially in Florida, the states of the Southwest, and southern California, which all had centers high in the urban hierarchy. During the period between 1920 and 1960, there was a net migration of 11.4 million people to California (see Figure 4.17), Arizona, and Florida from other regions (Borchert, 1967, p. 321). Other places that gained during the period were metropolitan areas with universities.

4.5.5 A New Epoch, 1970–

Borchert (1991) would later mark 1970 as the beginning of a new epoch. The critical variables marking this separation were more costly energy and the electronic and jet propulsion technologies. A number of trend reversals were used to choose 1970 as the critical date, including (see Figure 4.18) the following:

1. Sharp reversal upward in the cost curve for energy raw materials;
2. Reversal toward greater efficiency of automobile fuel use;
3. Growing relative importance of the country's overseas commerce;
4. Upsurge in growth of American overseas cable, radio, phone, and later satellite, Internet, and cell phone messages;
5. Continuing increase in domestic long-distance calls, with the Internet expanding later; and
6. Increased per capita consumption of paper for record keeping, correspondence, magazines, and advertising circulars that has accompanied television, computing, word processing, and desktop publishing. This trend is countered in the 21st century by the upsurge of green concerns and efforts by governments and many organizations to reduce paper usage.

FIGURE 4.17 Volleyball players on a Los Angeles beach.

The striking difference between the largest 100 urban places in 1920 and those of 1970 was that the growth pattern driven by amenities and the service economy became more pronounced (see Figure 4.19 on page 123). In most cases, inertia explained the persistence of many of the largest cities. Those that had claimed good advantage with respect to the railroads in an earlier epoch were now well positioned with respect to the nation's interstate highway system and airports. Los Angeles grew from being the 10th largest city to being the 3rd largest, and Dallas and Houston entered the ranks of the top 10.

Perhaps the most systematic change was the appearance of cities in the top 100 that were once just on the outskirts of the previous epoch's large cities. For instance, Anaheim, Long Beach, Riverside, and Santa Ana, which are all clustered around Los Angeles, were now in the top 100, and all except Long Beach had joined those ranks for the first time in 1970. The trend intensified over next 30 years, with Huntington Beach and Glendale joining the other Los Angeles suburbs by 2000 (see Figure 4.20 on page 123). The phenomenon also appeared in metropolitan areas like Phoenix, with Mesa and Scottsdale now in the top 100 city list, and Dallas–Fort Worth, with Arlington, Plano, Garland, and Irving now included. Meanwhile, the places that fell out of the top 100 between 1970 and 2000 were indicative of the earlier epochs that gave rise to them, including places like Gary, Providence, Syracuse, and Evansville.

4.6 GLOBAL CITIES

Urban system research is becoming increasingly global in scope. This global approach is often referred to as a world cities approach, led by the hypotheses generated by the work of Cohen (1981), Friedmann (1986), and Sassen (2006). The key investigations include the concentration of corporate headquarters offices and subsequent concentration of financial power in a few large cities within a global network of cities. This centralization of top-level management and control functions runs counter to the spatial dispersion of other economic

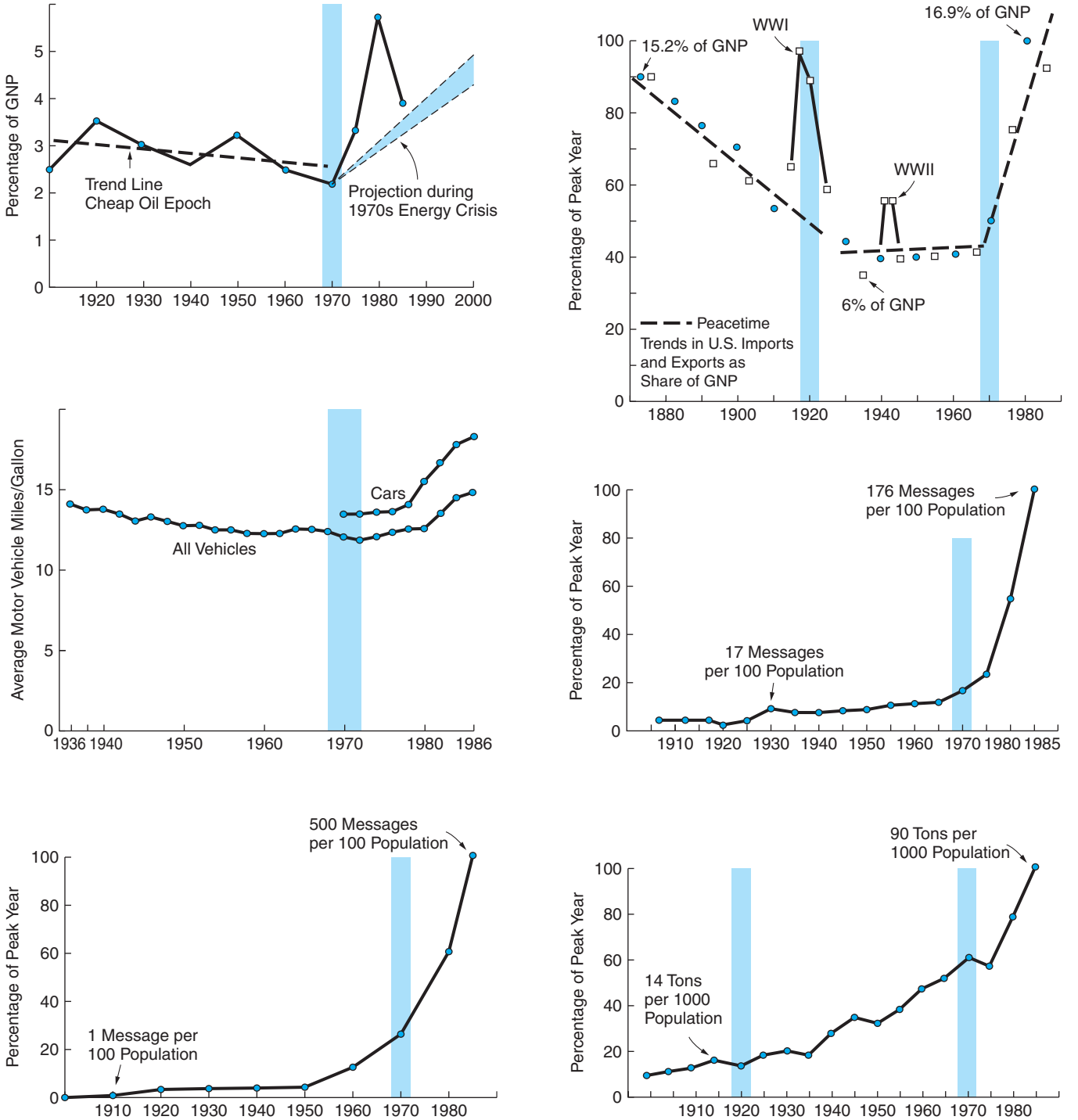


FIGURE 4.18 United States trends having 1970 as a critical year. *Source:* Hart, John Fraser, ed. OUR CHANGING CITIES. © 1991 The Johns Hopkins University Press. Reprinted with permission of The Johns Hopkins University Press. P. 228, Figures 12.6 & 12.7; P. 229, Figures 12.8 & 12.9; P. 230, Figure 12.10; P. 213, Figure 12.11. © 1991 The Johns Hopkins University Press. Reprinted with permission of The Johns Hopkins University Press. (a) Figure 12.6, Long-term trends in the cost of U.S. energy raw materials, p. 228. (b) Figure 12.7, Increased efficiency in response to the uncertain outlook for motor fuel cost and supply, p. 228. (c) Figure 12.8, Peacetime trends and wartime anomalies in total value of U.S. imports and exports expressed in percentage of gross national product, p. 229. (d) Figure 12.9, Long-trend in overseas messages (cable, radio, telephone) per capita of resident U.S. population, p. 229. (e) Figure 12.10, Long-term trends in U.S. domestic long-distance telephone messages per capita of resident population, p. 230. (f) Figure 12.11, Long-term trend in U.S. per capita of paper, excluding newsprint, packaging, industrial, and tissue, p. 231.

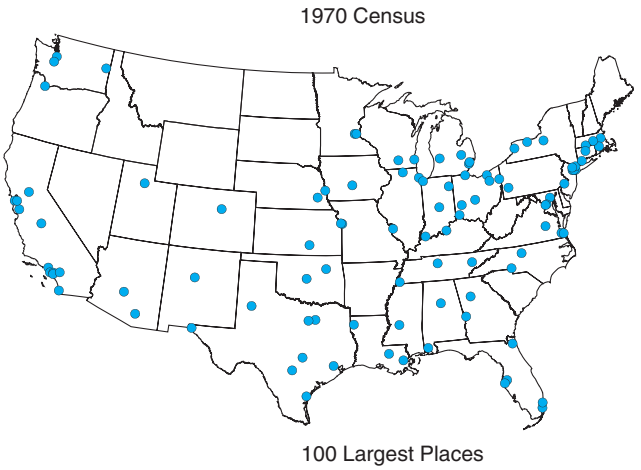


FIGURE 4.19 The 100 largest urban places recognized in the 1970 U.S. Census.

activities, such as manufacturing, that is typically associated with the process of globalization. Instead, high-level firms concentrate in global cities to command and control these dispersed activities.

According to Sassen (2001, 2006), the turnaround occurred in the 1960s with a profound transformation of economic activity in the world economy, including the industrialization of third-world countries and the internationalization of the financial industry into a worldwide network of transactions. New York, London, and Tokyo are the three principal global cities because they were prominent in finance to begin with and became even more specialized in the sector as their manufacturing base receded quickly. As a result, the global cities have emerged as control centers that set the rules for production and marketing worldwide (Knox, 1995). Examining these three cities, Sassen (2001) found that they now function in four new ways:

1. As highly concentrated command points in the organization of the world economy;
2. As key locations for finance and specialized service firms, which have replaced manufacturing as the leading economic sectors;
3. As sites of production, including the production of innovations, in these leading industries; and
4. As markets for the products and innovations produced. (pp. 3–4)

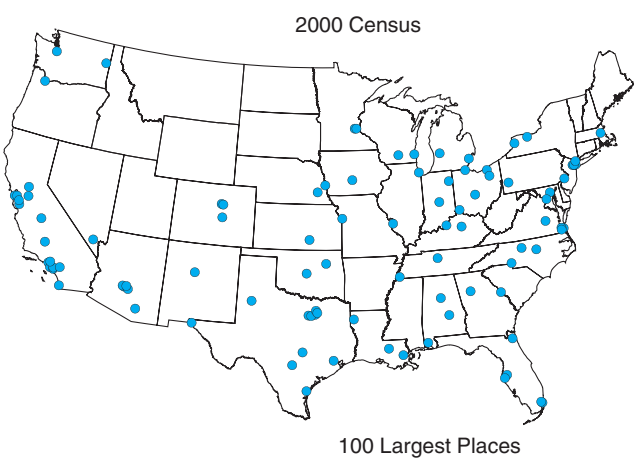


FIGURE 4.20 The 100 largest urban places recognized in the 2000 U.S. Census.

Sassen (2002) asked the question, Why do firms continue to clutch onto perceived benefits of agglomeration economies in light of new telecommunications and computer technologies? She then suggested that it is the result of the old notion of "face-to-face" contact, or what she termed business networks. Sassen further argued that the largest global cities have undergone massive and parallel changes in their economic base, spatial organization, and social structure. It follows from this argument that the new world city system transcends national institutions, politics, and culture and is based more on global economic processes.

Nevertheless, a number of researchers remain skeptical of the world cities approach. Hill and Kim (2000) contended that fundamental differences in economic base, spatial organization, and social structure persist between major cities in the North Atlantic and East Asian regions. They presented their case by contrasting Tokyo and Seoul with New York and London:

> Seoul, like Tokyo, has not experienced severe manufacturing decline, rapid expansion in producer service employment, extensive foreign immigration or much social and spatial polarisation. Like Tokyo, Seoul is under the sway of a political bureaucratic elite, not a transnational capitalist class. And, as with Tokyo, it would be senseless to claim that Seoul is severing ties of mutual interest with the nation-state; if anything, the capital city is becoming even more integrated with the rest of South Korea. (Hill & Kim, 2000, p. 2186)

Esparza and Krmenec (2000) made a similar claim for the United States, where they noted that, at the same time that urban system analysts have become increasingly focused on world city hypotheses, large urban centers at the top of the U.S. urban hierarchy still have significant interaction (trade) with other large urban centers in the U.S. urban system, as well as with smaller cities within their regional trade areas. Likewise, McCann (2004) pointed to a polarization in urban studies research between global cities and cities outside of the global domain. Citing the globalization processes impacting Lexington, Kentucky, McCann suggested that many key aspects of globalization effects on cities are being missed in the dialogue within the global cities literature.

Sassen (2002, 2006) also recognized these national and regional interactions, although her emphasis was clearly that global cities become more closely linked to the global economy than they do to their regional or national economies, the consequence of which is an eventual pushing out of firms and people not connected to the internationalized sector. Thus, the world cities or global cities perspective is multifaceted, with some attention placed on the consequence of cities not interacting at the top of the hierarchy.

Another key topic within global cities research includes social and economic dislocation resulting from the concentration of financial resources in the few largest cities. Boschken (2003)

addressed the concentration of upper-middle-class population caused by the processes leading to global cities. Boschken devised a classification of a number of U.S. cities along 10 dimensions associated with global cities, which include monolithic core city, center of banking/consulting/knowledge, entertainment center, world class universities, international seaport and/or airport, and severe roadway congestion (see Figure 4.21). The map indicates, for each city, how many dimensions are global. He found that the urban areas having the greatest number of global-interface functions also tended to have relatively high concentrations of upper-middle-class residents. Boschken (2003) saw the implications of this trend towards upper-middle class presence as follows:

> The achievements of [upper-middle-class]-inspired global-city development have brought the world to the doorstep of those endowed with the educational resources and professional ties that give them entrée to the platform of global connectivity. But globalization is not without trade-offs. As we look outward to a world that, for the most part, seems to be enthusiastically "globalizing American culture and cultural icons" (Friedman, 2000, p. 380), the look inward reveals an unparalleled challenge for American global cities in dealing with nagging problems of dislocation, dissension among cultural variants, and growing competition between values—some global, some provincial. Moreover, in forming urban policy in a global environment, subtle revisions have taken place in social consciousness and in policy makers' striving for social program effectiveness. (p. 824)

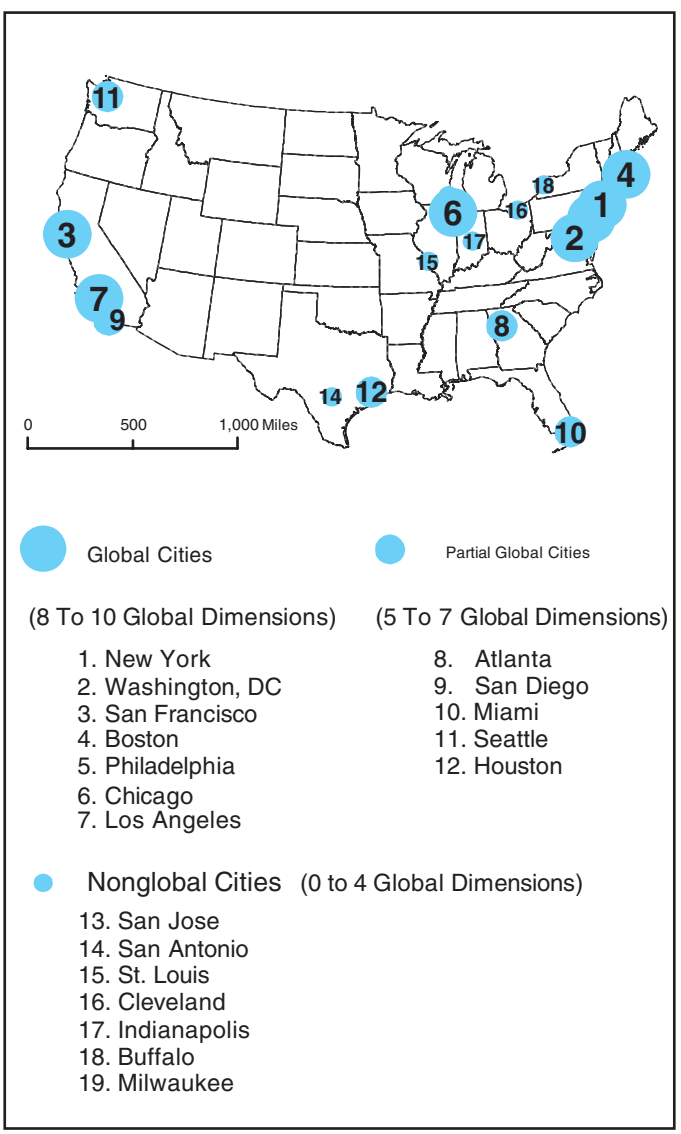


FIGURE 4.21 Global status for U.S. cities.

Other dislocations have been observed as a result of the global city phenomenon. For instance, Warf and Erickson (1996) noted that the high and rising incomes of the professional class associated with the large firms and banks of these global cities have encouraged neighborhood gentrification by indirectly raising real estate prices within those cities. Displacement of low-income residents by the process of gentrification is well documented (discussed at length in Chapter 5). Chiu and Lui (2004) demonstrated that Hong Kong underwent a process of occupational and income polarization in the 1990s as it was transformed into a global city. The polarization in Hong Kong also had a gender dimension, as women filled more of the new low-skilled and low-paying jobs associated with the expansion of the service sector (Chiu & Lui, 2004).

4.6.1 Global City Examples

This section presents contrasting examples of global cities in the developing world. First, the African global city of Johannesburg is examined. Then the Indian global city of Mumbai is contrasted.

Johannesburg, South Africa's largest city, was founded as a result of discovery of gold in reefs in the Witwatersrand mountains. It has grown from an urban agglomeration of 900,000 in 1950 to an estimated population of 3.62 million in 2010 (United Nations, 2008)—that is, it has grown at a yearly rate of 2.3 percent. By contrast, Africa's largest city, Lagos, Nigeria, has a 2010 estimated population of 10.57 million, growing over 60 years at 5.9 percent annually. However, South Africa, with a gross domestic product (GDP) per capita in 2007 of U.S.$9,560, is one of the continent's wealthiest nations. Johannesburg is the richest large city in South Africa, with average income per capita in 2006 of U.S.$7,500, which compared to Cape Town's U.S.$5,466 (City of Johannesburg, 2009b). In the second half of the 20th century, until the Apartheid era ended in 1994, Johannesburg was the "premier city of a pariah state increasingly isolated from a shrinking world that was already in the early stages of globalization" (Beavon, p. 50, 2006). The 1980s city was on the decline, as it had lost its gold mining, manufacturing, and financial leadership to other cities in Africa and suffered from increasing ostracism by the rest of the world (Beavon, 2006). At that time, the city's global elements stemmed from the isolated business and lifestyle of its White elite (Simone, 2008). It could be regarded as a city with potential for global status, but constrained by the

political conflict of Apartheid, both within the city and between it and the rest of the world.

During the Apartheid era in the 1980s, "white flight" started from the CBD, sparked by the Soweto Riots and increasing signs of disturbance and protest. Many businesses began to move from the CBD to the new northern towns of Sandton and Randburg (Beavon, 2006).

After the Apartheid era ended in 1994, the city underwent restructuring. The Whites who lived formerly in the city center largely moved to the far north suburbs, where they could establish better security and find many growing business centers. The city center, vacated by the middle class, became 90 percent occupied by migrants who were mostly poor and engaged in low-level work; some were unemployed and some engaged in illicit activities (Simone, 2008). In 1995, the first city government elections were held for an amalgamated city that now included Johannesburg plus the wealthy suburbs of Sandton and Randburg; Soweto, the formerly Apartheid Black city; and several other areas. In 2000, Johannesburg transitioned to unified metropolitan authority having an elected executive mayor and government, with further expanded city limits.

Johannesburg is today a global city because of its dominant position as a financial center in Africa, but it is polarized and still in the throes of socially adapting to its economic power (Nuttall & Mbembe, 2008). It hosts the headquarters of over 70 percent of the major firms in South Africa and is the world center for the diamond industry, important for other minerals, and a continental and global trading center. It has Africa's largest stock exchange, JSE Limited, and world-class infrastructure in telecommunications, finance, and transportation (City of Johannesburg, 2009b). In 2006, the city's gross value added (GVA; similar to GDP minus taxes and subsidies) was 27 percent in finance and 17 percent in trade.

On the problematic side are deteriorated parts of the city, high unemployment and poverty, continuing social and economic polarization, and high crime rates. This stems from the redistribution of the city center in the late Apartheid period and early democratic period—with huge outflows of businesses and the middle class to the outlying suburbs, especially Sandton and Randburg, and inflow to vacated structures of a poor Black population. These trends led to overcrowding, rental tensions, blight, waste accumulation, and high crime rates (Beavon, 2006; Simone, 2008). Some other formerly segregated areas have remained poor. For example, Soweto, a formerly segregated city on the southwest outskirts of Greater Johannesburg, remains a poor section, with limited utilities, degraded environment, substandard housing, and reduced education and life chances (Figure 4.22). These issues are reflected in the city's very high rates of unemployment (40 percent in 2006) and poverty (24.1 percent in 2005). However, the latter rate breaks down to reflect social divisions, since it is 2.8 percent

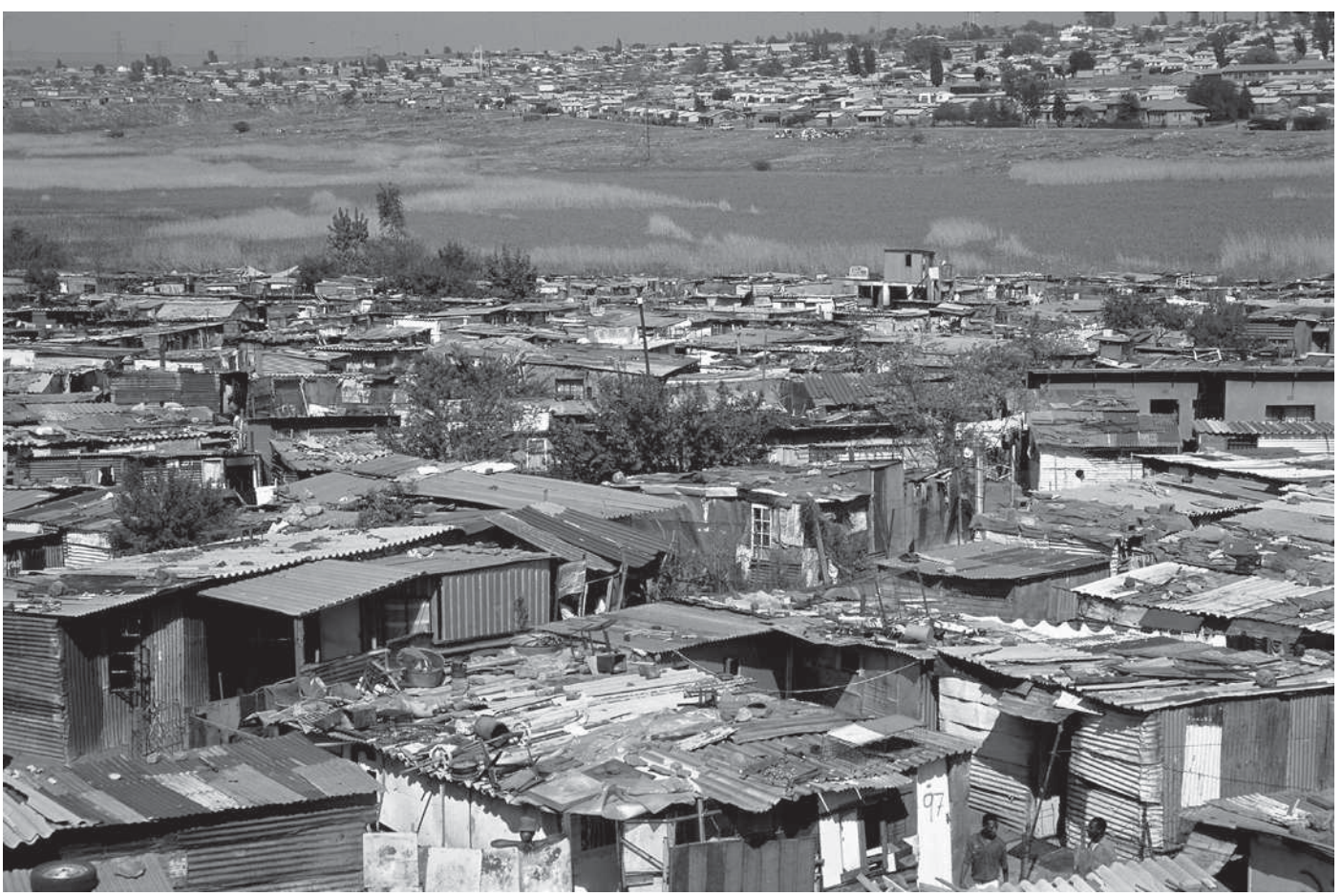


FIGURE 4.22 Soweto slum in Greater Johannesburg: globalization's underside.

for Whites, 6.5 percent for Asians, and 32.3 percent for Blacks (City of Johannesburg, 2009a).

There are hopeful signs, including strong initiatives by the executive mayor to change the economy and the approval of Joburg 2030, a long-term strategic city plan for economic development to improve the quality of life for all citizens. In short, Johannesburg has emerged in the democratic period to exert world leadership in finance and minerals and to be the continental business leader. It meets the criteria for a global city, but is still undergoing spatial and social restructuring to overcome polarizations and deficits, many residual from the Apartheid era.

Mumbai is the largest metropolitan area in India. It was ranked sixth among world megacities in terms of consistently defined metropolitan area (CDMA) size (Forstall, Greene, & Pick, 2009), with a 2003 population of 19.2 million. It is among the fastest growing of the world's top 10 megacities at 2.5 percent yearly, which points toward its moving within decades to second or third place worldwide in size. The population has grown fourfold since Indian independence in 1947. Like Johannesburg, Mumbai has striking differences between rich and poor.

Originally seven islands, Mumbai was long ago converted into a single city island. Under British rule, the city was a naval base and expanded into major cotton production. When the U.S. Civil War reduced cotton supply on the world market, Mumbai seized the opportunity and took over as a principal supplier, also stimulating its financial sector.

Mumbai today is the leader of India and south Asia in finance and entertainment, as well as being India's corporate decision-making center. It has the nation's two leading stock exchanges and accounts for most of India's banking and credit transactions (Municipal Corporation of Greater Mumbai [MCGM], 2005). The city would like to develop more into a global financial hub equivalent to New York, London, and Tokyo, where foreign and domestic business takes place in a similar regulatory environment (MCGM, 2005). Along with its financial importance, it has a large subsector of financial and business services, as well as a sophisticated, trained professional workforce. The proportion of Mumbai's employed workforce in the tertiary sector grew from 63 percent in 1980 to 81 percent in 1998 (Mumbai Metropolitan Region Development Authority, 2003). This huge service sector supports the finance and entertainment segments, as well as other huge corporate and government needs. The city's entertainment sector is an Asian, and increasingly a global, force. The film subsector, known as Bollywood, produces more than 1,000 films yearly, exceeding Hollywood. The films are upbeat, often with a romantic plot with a happy ending, and fast moving, with an emotional panoply and lots of singing and dancing (Pomeroy & Dutt, 2008). They are usually in Hindi, although some are in English.

Mumbai is a global transport center, with India's largest port. It has an emerging sector of information technology (IT) located in the suburbs. However, global leadership in IT in India is centered in Bangalore, a smaller urban agglomeration of 7.2 million persons (United Nations, 2008), located in the center south. It has grown rapidly since Indian independence in 1947 and has become in the past two decades a global leader in technology outsourcing. Bangalore's IT industry, however, thrives on efficiency, cost-cutting, and performance, rather than innovation. The city is not yet quite diversified enough, large enough, or financially strong enough to be a global city, although it might reach that level in the future.

With its leadership in finance in a country with one of the fastest growing among the world's largest economies, its innovation leadership in entertainment, and its increasing tertiary services, Mumbai has the characteristics of a global city, as discussed earlier in the chapter. Its financial center is closely clustered in a high-rise district on Nariman Point (see Figure 4.23).

However, although it is India's business capital, it is considered India's most unequal large city (McFarlane, 2010). Mumbai has the problems of lack of sufficient land for development, huge slums, inefficient government bureaucracy, and deficits in regulatory powers for finance and infrastructure (MCGM, 2009). Its informal settlements suffer from poor-quality housing, disease, monsoon rain damage, lack of access to basic services such as sanitation and drinkable water, and frequent demolitions by the city (McFarlane, 2010). The land squeeze partly stems from its historical location on an island. Our analysis of the world's largest megacities (CDMAs) includes for Mumbai the historical island as well as coastal land that totals 2,500 square kilometers. The metropolis's population density of 8,150 persons/km^2 is double that of Tokyo and Seoul and 10 times that of New York. Scarcity of land leads to very high prices, which contribute to marginalizing the poor and pressuring small businesses. Mumbai's vast slums include usually one-room residential tenements built by factories and the government, shantytowns at the side of roads, and informal squatter settlements (MCGM, 2009). About half of Mumbai's population lives in about 2,000 slum settlements, which are spread out all over the metropolitan area. The slum dwellers have very small living units, mostly inadequate sanitation and water supply, very limited garbage collection, reduced access to financial credit, and limited educational opportunity (MCGM, 2009).

In summary, Mumbai, while considerably more advanced economically than Johannesburg, illustrates a developing-world global city that is bifurcated into sections that are world class, important in global business, prosperous, and often luxurious, offset by other sections of huge slums, poverty, and misery. Its urban planning has so far lacked the vision, leadership, and resources to move toward greater economic evenness and a base of adequate social services.

4.6.2 Analyzing an Urban Issue (China's Changing Urban Hierarchy)

China's population has urbanized rapidly, especially in the last 20 years. According to the United Nations, China's urban population percentage was 23 percent in 1985, but that percentage had increased to 40 percent by 2005 (United Nations, 2008). Although the urban share of China's population is relatively low when compared to countries of the developed world, the total urban population of China is 531 million, which makes it the country with the world's largest urban population. Even more impressive is the recent and projected

FIGURE 4.23 Mumbai's main financial center at Nariman Point.

growth of China's cities, as the average annual urban growth rate was 3.10 percent between 2000 and 2005 (United Nations, 2008). Some caution is warranted due to errors in the statistics on individual cities, which the United Nations bases as much as possible on its concept of *urban agglomerations*; also, available Chinese data are often overbounded—that is, referring to a larger territory, which may include a substantial rural population. Nevertheless, China's recent urban growth is unprecedented historically.

Mainland China's 137 largest urban agglomerations have not all grown equally during this rapid phase of urbanization (1985 to 2005), and as a result, urban population rankings have changed significantly (Table 4.2). A simple approach to visualizing China's changing urban hierarchy would be to map the population change percentages for the 137 urban agglomerations (see Figure 4.24 on page 130). However, it is also of interest to see how urban agglomerations have moved up and down in rank between 1985 and 2005, which is masked in the percentage change map.

A GIS analysis was performed of rank changes for China's urban agglomerations for the 1985-to-2005 period to identify regional patterns of change (see Figure 4.25 on page 131). The rank mobility index map shows the spatial pattern of the rank mobility index (RMI) computed for the 137 urban agglomerations (Marshall, 1989). The RMI is a measure of a city's change in population rank among a group of cities:

$$M = \frac{(R1 - R2)}{(R1 + R2)}$$

where M is the RMI, $R1$ is the city's rank at time 1, and $R2$ is the city's rank at time 2. An RMI value can range from -1.0 to $+1.0$. A negative RMI value indicates a decrease in rank, whereas a positive RMI value reflects an increase in rank. An RMI value of 0 indicates no change in rank. Eleven of China's 137 urban agglomerations had RMI values of 0, while 52 had positive RMI values and 74 had negative RMI values. It is clear from Figure 4.26 (page 132) that China's greatest concentration of positive RMIs is in the southern coastal regions of the country.

The use of the RMI is especially appropriate for studying the changing dominance of urban agglomerations in China because RMI values are larger when rank increases at high levels are involved. A rank change carries more weight when it is higher on the list of rankings. The larger the urban agglomeration, the more difficult it is to overtake. For example, let us examine the urban agglomeration of Nanning in southern China. In 1985, Nanning was the 53rd ranked urban agglomeration in China. In 2005, it was the 35th ranked urban agglomeration in China, resulting in an RMI value of 0.20 for the period from 1985 to 2005. Let's examine another city that also moved up 18 positions, Yinchuan in northwestern China. Yinchuan's rank increased from 119 to 101; however, its RMI was only 0.08. An equal-sized change in ranking did not result in an equally large

TABLE 4.2 China's Urban Agglomeration Rankings: 1985 to 2005.

Urban Agglomeration	Pop 1985 (000)	Pop 2005 (000)	Rank 1985	Rank 2005
Shanghai	7901	14,503	1	1
Beijing	6890	10,717	2	2
Guangzhou	3417	8425	6	3
Shenzhen	495	7233	104	4
Wuhan	3458	7093	5	5
Tianjin	5474	7040	3	6
Chongqing	2808	6363	7	7
Shenyang	4236	4720	4	8
Dongguan	1344	4320	26	9
Chengdu	2639	4065	9	10
Xi'an	2429	3926	10	11
Nanjing	2302	3621	12	12
Haerbin	2702	3566	8	13
Guiyang	1440	3447	22	14
Dalian	1793	3073	15	15
Changchun	1909	3046	14	16
Zibo	2323	2982	11	17
Kunming	1493	2837	18	18
Hangzhou	1291	2831	31	19
Qingdao	1460	2817	20	20
Taiyuan	1932	2794	13	21
Jinan	1667	2743	16	22
Zhengzhou	1542	2590	17	23
Fuzhou	1223	2453	34	24
Changsha	1165	2451	37	25
Lanzhou	1489	2411	19	26
Xiamen	556	2371	93	27
Shijiazhuang	1172	2275	36	28
Jinxi	943	2268	54	29
Jilin	1164	2255	38	30
Wenzhou	543	2212	96	31
Nanchang	1133	2188	39	32
Zaozhuang	1423	2096	24	33
Nanchong	325	2046	129	34
Nanning	964	2040	53	35
Linyi	1453	2035	21	36
Urumqi	1029	2025	46	37
Yantai	515	1991	101	38
Xuzhou	837	1960	63	39
Baotou	1127	1920	40	40
Hefei	917	1916	58	41
Suzhou1	215	1849	134	42
Nanyang	307	1830	130	43
Tangshan	1391	1825	25	44
Ningbo	1023	1810	47	45
Datong	1074	1763	42	46
Tianmen	1425	1676	23	47
Shangqiu	204	1650	135	48
Liuan	1301	1647	29	49
Wuxi	881	1646	60	50
Luoyang	1055	1644	44	51
Hohhot	810	1625	68	52
Anshan	1295	1611	30	53
Qiqihaer	1288	1607	32	54
Taian	1322	1598	27	55
Daqing	844	1594	62	56
Suzhou2	743	1553	73	57
Handan	993	1535	50	58
Xiantao	1310	1528	28	59
Zhanjiang	931	1514	57	60
Weifang	779	1498	71	61
Shantou	780	1495	70	62
Fushun	1263	1456	33	63
Xinyang	239	1450	133	64
Luzhou	340	1447	126	65
Neijiang	495	1441	103	66
Changde	992	1429	51	67
Huainan	1097	1420	41	68
Liuzhou	643	1409	78	69
Suining	1183	1401	35	70
Quanzhou	435	1377	116	71
Mianyang	812	1322	67	72
Heze	1040	1318	45	73
Yiyang	939	1313	55	74
Changzhou	577	1249	89	75
Huai'an	1073	1243	43	76
Chifeng	601	1238	86	77
Huzhou	976	1203	52	78
Tianshui	826	1199	65	79
Mudanjiang	640	1171	79	80
Liupanshui	757	1149	72	81
Jining	633	1143	81	83
Leshan	996	1143	49	82
Zigong	912	1087	59	84
Xianyang	576	1072	90	85
Yulin	572	1060	92	86
Baoding	535	1042	99	87
Zhuzhou	451	1016	113	88
Xiangfan	373	1006	123	89
Zhangjiakou	646	1001	77	90
Benxi	844	1000	61	91
Yongzhou	931	991	56	92
Xining	616	987	84	93
Hengyang	587	973	87	94
Jiamusi	575	969	91	95
Zhuhai	187	963	137	96
Yichun2	816	961	66	97
Jiaxing	696	954	75	98
Jixi	792	947	69	99
Qinhuangdao	444	944	115	100
Yinchuan	410	932	119	101
Guilin	474	929	108	102
Jinzhou	631	925	82	103
Pingxiang	488	905	106	104
Nantong	418	891	118	105
Foshan	333	888	127	106
Yibin	360	872	124	107

TABLE 4.2 China's Urban Agglomeration Rankings: 1985 to 2005. (continued)

Urban Agglomeration	Pop 1985 (000)	Pop 2005 (000)	Rank 1985	Rank 2005
Xinyu	540	870	98	108
Bengbu	606	867	85	109
Xinxiang	546	863	94	110
Pingdingshan	628	861	83	111
Huaibei	476	858	107	112
Tongliao	462	855	112	113
Xuanzhou	743	851	74	114
Anyang	544	849	95	115
Kaifeng	636	848	80	116
Yueyang	1016	847	48	117
Dandong	581	841	88	118
Yichang	407	823	120	119
Anshun	472	822	110	121
Jiaozuo	529	822	100	120
Zhenjiang	394	803	121	122
Zunyi	360	799	125	124
Linfen	386	799	122	123
Yancheng	426	789	117	125
Yuci	330	785	128	128
Xingyi	541	785	97	127
Yichun1	832	785	64	126
Zhaotong	474	783	109	129
Langfang	273	780	131	130
Wuhu	490	774	105	131
Liaoyang	513	773	102	132
Lianyungang	444	768	114	133
Yingkou	471	764	111	134
Shaoxing	243	731	132	135
Fuyang	191	726	136	136
Fuxin	680	725	76	137

RMI, reflecting the fact that it is more difficult to overtake a larger urban agglomeration. Incidentally, both these urban agglomerations more than doubled their populations over the 20-year period, but Nanning, with slightly more than 2 million people, exceeds Yinchuan by more than 1 million people.

Focusing on the contrast between RMI values in North and South China illustrates the power of the RMI for spatial analysis. Consider, for instance, the south coastal arc stretching from Hangzhou to Guangzhou, with RMIs that were all greater than the average for increasing RMIs (see Figure 4.25 on page 131). Many of the cities in this coastal arc—including Hangzhou, Ningbo, Wenzhou, Quanzhou, Xiamen, Shenzhen, Dongguan, and Guangzhou—had positive RMI values that were three standard deviations over the average RMI. The reason for these positive climbs up the urban agglomeration hierarchy is that in the early to mid-1980s the Chinese central government designated many of the coastal cities (Shenzhen, Zhuhai, Xiamen, and Shantou) as special economic zones, or "coastal open cities," which meant that they provided incentives to attract foreign investment and experienced multiple economic booms as a result during the late 1980s and 1990s. In a recent study on the economic, social, and environmental competitiveness among 253 Chinese cities in the year 2000, Jiang and Shen (2010) showed that Shenzhen and Zhuhai along with neighboring Guangzhou benefited from these policies as they were in the top five in terms of economic competiveness while Zhuhai also ranked number one in environmental competitiveness. Other variables can also be considered in determining why certain urban agglomerations overtook others in population during the 1985-to-2005 time period (Figure 4.25 on page 131). For instance, proximity to Hong Kong played an important role in the amazing RMI increase for Shenzhen. It went from position 104 in 1985 to position 4 in 2005, for an RMI of 0.93. Shenzhen's population grew from approximately half a million in 1985 to 8.9 million in 2009. Shenzhen is part of the Pearl River Delta urban system anchored by Hong Kong and Guangzhou, an area that has been filled in with many factories and sprawling residential developments that support a strong, export-oriented economy (Figure 4.26 on page 132). On the opposite side of the delta are Macau and its mainland border city of Zhuhai, which are similar to Hong Kong and Shenzhen in that they are physically separated by a secure border. Despite the physical separation, both of these twin city pairs have become economically closely integrated, with substantial cross-border investment and even some daily commuting of residents between each of the twins.

The RMI measure gives a quick insight into the changing urban agglomeration hierarchy within a country and identifies urban agglomerations that are strengthening or weakening relative to others. This ranking of places may be more important for some purposes, such as determining the best place to locate a business based on consumer market gains or identifying the places with the worst declines in rank, than are their total percentage gains or losses. RMI is a useful indicator of population, economic change, or social change, depending on which characteristic is chosen for the index. It constitutes a good measure for this chapter, which is concerned with change in cities.

This chapter's exercise involves computation of the RMI maps for the populations of China's cities to show rank changes during the 1985-to-2005 period. The focus is on profiling China's recent urban growth and critiquing the use of the RMI for urban analysis. The exercise and its suggested essays draw on concepts and facts from this chapter's sections.

4.7 MODERN RESEARCH ON URBAN SYSTEMS

The urban system approach continues to be an active realm for research. Consider, for instance, a study on urban poverty, a topic that has been frequently approached in the past from an intraurban perspective. Strait (2000) examined rising poverty concentration in American cities as a function of complex employment changes taking place across metropolitan

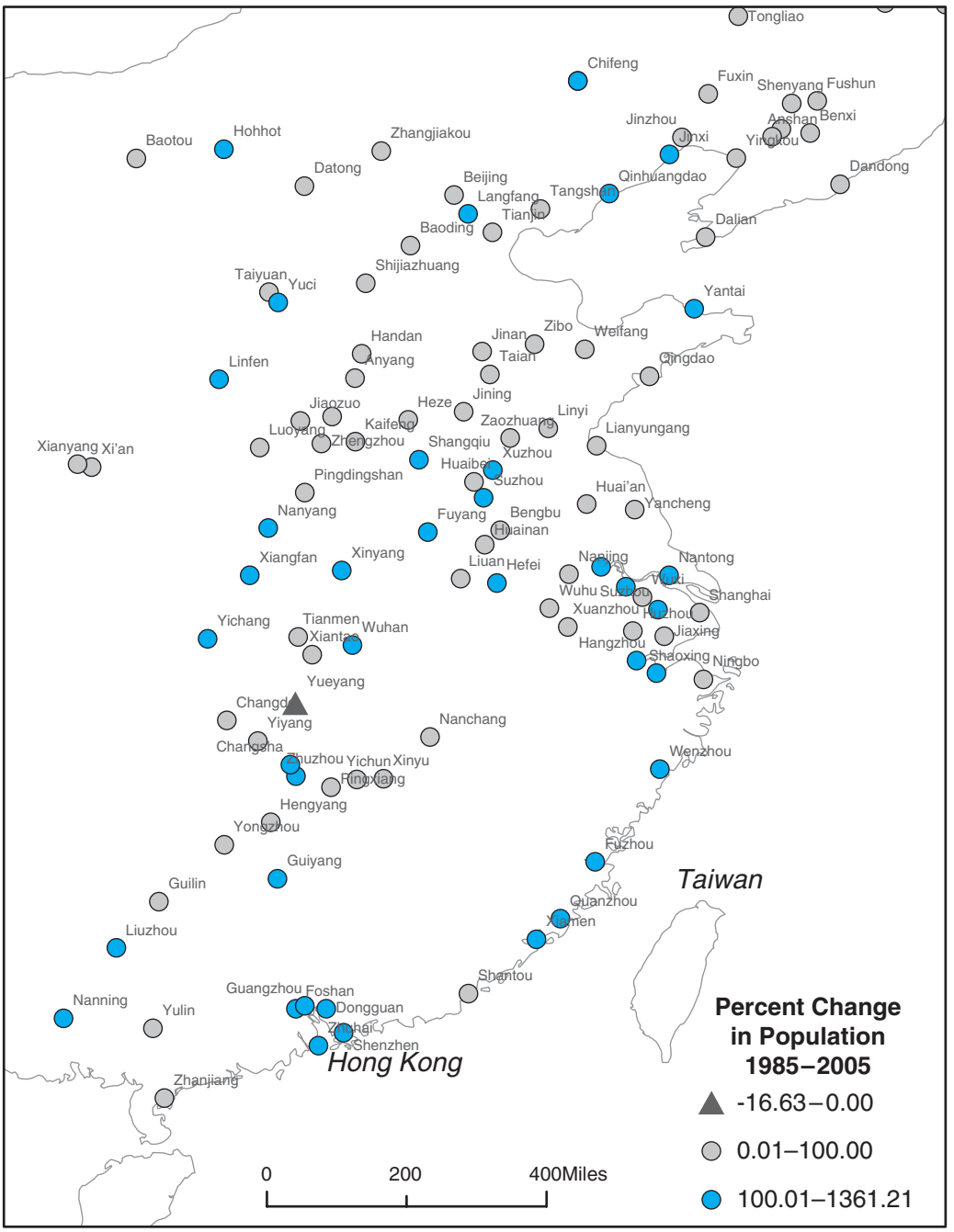


FIGURE 4.24 Percentage of change in China's urban agglomeration populations (1985 to 2005).

areas and the impact of such changes on poor neighborhoods within cities. Strait (2000) found a significant relationship between metropolitan employment growth and the growth in extreme poverty at the neighborhood level. That study follows in the same tradition as the ones reviewed earlier in that it considers city responses to stimuli induced from higher up, at the same level, or from lower down on the urban system's hierarchy.

The more classic urban system topics continue to be examined by urban researchers. For instance, Dehghan and Uribe (1999) examined the role of central government expenditures in shaping the city size distribution in Mexico. Marshall (1997) pointed out weaknesses in applying the traditional rank-size rule at the scale of a metropolitan region and introduced an alternative he called the constant-Gini model. Berry (1991, p. 31) found that, after Borchert (1967) produced his seminal article on the evolution of the urban system, other variations on the theme were soon to follow, such as that by Dunn (1980), who hypothesized five rather than four evolutionary epochs. Conzen (1981) focused on the 19th-century American urban system and provided a more detailed analysis of that period than Borchert (1967) was able to provide when covering five epochs. Focusing on the post–World War II period, Noyelle and Stanback (1983) developed a functional classification of American cities on the basis of the recent economic transformation of the U.S. economy from an emphasis on manufacturing to one on services, a topic that is addressed in Chapter 9.

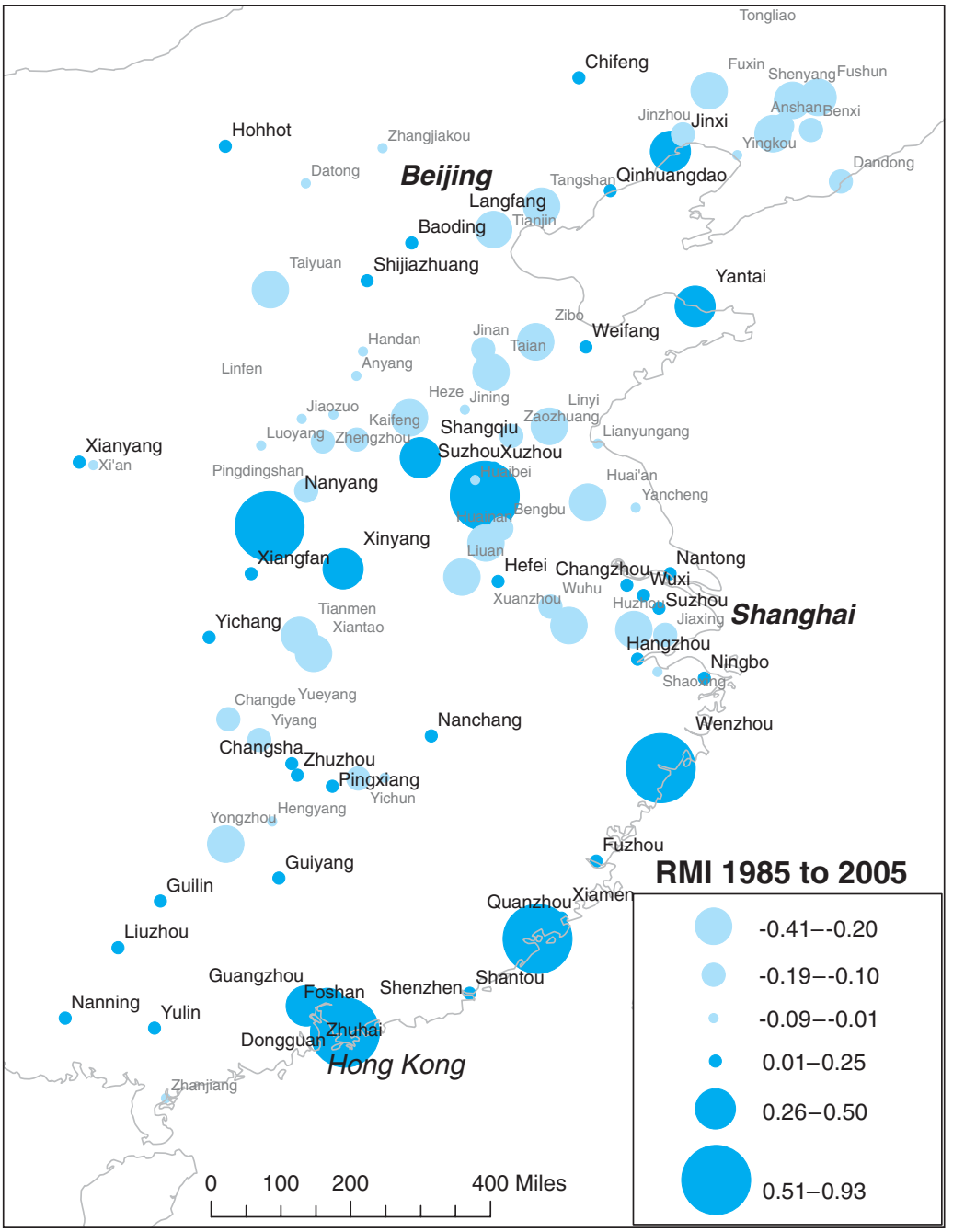


FIGURE 4.25 Rank mobility index for China's urban agglomerations (1985 to 2005).

Berry (1991) himself attempted to provide an explanation for the timing of the technological innovations of Borchert's (1967) epoch boundaries by applying a long-wave theory (known as Kondratiev waves) of technology successions. Each wave is divided into the four phases of prosperity, recession, depression, and recovery. When economic growth declines, firms become reluctant to invest and unemployment rises. Eventually, the trough of the wave is reached, and economic activity is stirred up again on the basis of the key technologies identified by Borchert. Neal (2010) also looked at changes in the U.S. urban hierarchy, but rather than citing waves he argued that improved networks between cities better explain upward shifts in city rank. In discussing the topic of global networks of cities, Short (2004) introduced the idea of "black holes" in the network, referring to large cities not classified as world cities because of lack of connectivity to the remaining hierarchy. Myer (2003), commenting on the state of research on the global network of cities, contended that the area continues to advance in terms of empirical research, but that the theory of a global network of cities is still very much undeveloped. All of these works demonstrate that there is current interest in the urban system approach and that its tradition, dating back to central place theory, continues to influence the modern-day urban geographer's interpretation of global, regional, and local urban landscapes.

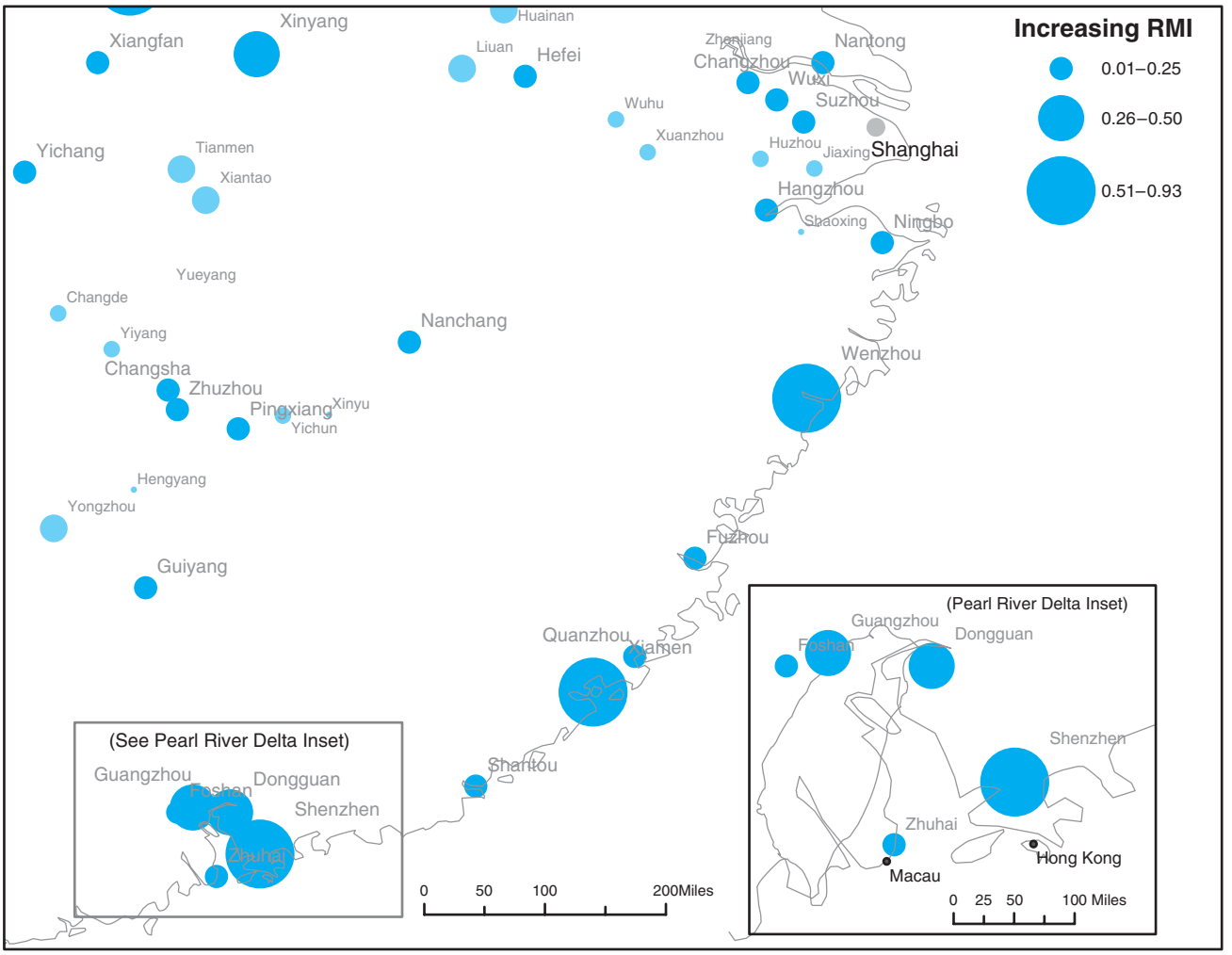


FIGURE 4.26 Southern China's rank mobility index pattern (1985 to 2005).

Summary

This chapter examined urban system approaches to urban geography. It covered basic concepts and principles and then moved to several examples. It reviewed the earliest and most prominent of these models, central place theory. A classic study of central place theory in Snohomish County, Washington, was examined and updated with contemporary data and spatial analysis. The chapter then discussed an evolutionary model of the American urban system that explained the hierarchy at any given time as a function of the state of transport and energy technology. A global cities approach to urban systems research is rising in popularity as economic transformation and globalization processes result in concentration of financial and high-end professional and executive resources in a select few large cities. Case studies of Johannesburg and Mumbai illustrated the achievement of global stature but also the accompanying problems of poverty, poor housing, and disease. The "Analyzing an Urban Issue" section used rank size distributions and the RMI index to study China's urban hierarchy. The Chinese urban system is the world's largest and one of its most rapidly growing and changing, bringing both economic and social prospects and problems, some addressed in subsequent chapters.

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Exercise

Exercise Description
Mapping and interpreting rank changes for China's urban agglomerations for 1985 and 2005.

Background Information
In this exercise, you will be working with the 1985 and 2005 population ranks of urban agglomerations in China.

Rank Mobility Index (RMI): Calculated by using an urban agglomeration's population rank at two particular times.

$$M = \frac{(R1 - R2)}{(R1 + R2)}$$

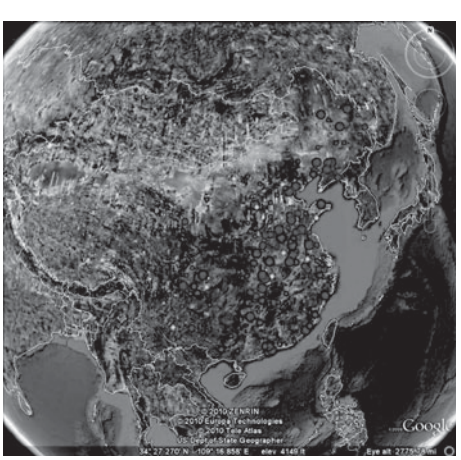
where M is RMI, R1 is the city's rank at time 1, and R2 is the city's rank at time 2.

An RMI value can range from –1.0 to +1.0. A negative RMI value indicates a decrease in rank, and a positive RMI value indicates an increase in rank. An RMI value of 0 indicates no change in rank. The use of the RMI is especially appropriate for studying the changing dominance of cities within an urban hierarchy because RMI values are larger when rank increases at high levels are involved. A rank change carries more weight when it is higher on the list of rankings. The larger the city is, the more difficult it is to overtake.

Google Earth Version

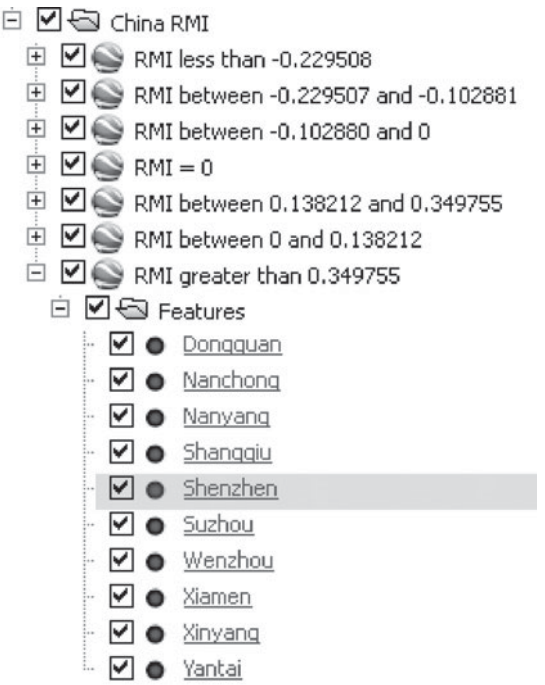
1. Launch the Chapter 4 Google Earth KMZ file by double-clicking it:
   EUC_Ex4.kmz
2. Expand China RMI to see the different range values of RMI (rank mobility index).

3. Note that when Google Earth opens the urban agglomerations of China, they are sized and color coded by RMI.



Red = Positive, Blue = Negative, Yellow = No Change

4. Print the map to a file to be submitted with your essay:
   File > Save > Save Image
   Navigate to where you want to save the file and give it a name (China RMI.jpg).
5. Expand the highest RMI category (RMI greater than 0.349755). Expand its features, and double-click on Shenzhen to zoom to this city that borders Hong Kong.



Shenzhen is a remarkable story of urban growth. It was ranked as the 104th largest urban agglomeration of China in 1985, but climbed to 4th position by 2005, with more than 7 million residents. Shenzhen's phenomenal urban growth was sparked by its location relative to Hong Kong and the Pearl River Delta, where it is neighbors with other high-RMI cities, including Dongguan, Guangzhou, and Zhuhai.

6. Navigate around Shenzhen, and look for evidence of its modern urban form, including an advanced transportation network. After Beijing, Shenzhen has the most registered automobiles in China. To provide more context, place a check mark next to 3D Buildings under Primary Database under Layers. Clicking a 3-D building will open a window that provides information about the building. Shun Hing Square is the fifth tallest building in China and the ninth tallest in the world. In 2011, it is expected to lose its title of tallest building in Shenzhen to the nearby Kingkey Finance Tower.

Place
Model
by RodrigoCosta
Shun Hing
Shun Hing Square (Chinese: 信兴广场/地王大厦) is a 384m (1,260 ft) tall skyscraper in Shenzhen, China. It is the tallest steel building in China, the 5th tallest building in China, and the 9th tallest in the world. It was the tallest building in China from its completion in 1996 until CITIC Plaza in Guangzhou was completed the next year. The building was built at the fast pace of four floors in nine... [more] -
Description and model provided by RodrigoCosta
Google 3D Warehouse
Made with Google SketchUp
This model was made with SketchUp, a 3D modeling tool from Google. Learn more »
Model your world
Report a problem

7. Turn off 3D Buildings and Roads, and double-click on another urban agglomeration in the highest RMI category. Explore this city for evidence of recent urban growth.

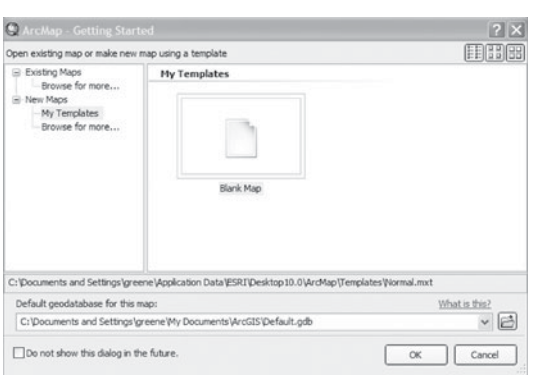
   Note: Several of the urban agglomerations might not have resolution of high enough quality when zoomed in on. The reason is a lower-resolution satellite imagery source. In that instance, please pick a different urban agglomeration.

8. Exit Google Earth when you are finished.

Google Earth Short Essay: Select and zoom in to two cities in the lowest category of RMI change for 1985–2005. After examining the overall location of the cities in China and the zoom-in details of the cities, use your Google Earth–based analysis to offer some reasons why each of these cities might have had a large drop in rank over the 20 years. You can bring forward additional reasons why they sharply declined in rank by referencing other literature or web-based sources. Be sure to cite those references.

ArcGIS 10 Version

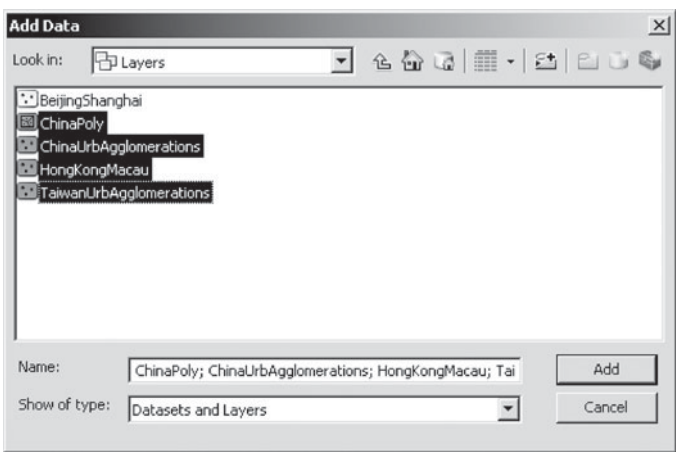
1. Start ArcMap. Under New Maps, click My Templates, and then double-click the Blank Map template.



2. Click the Add Data button, navigate to the exercise data folder, open ChinaCities, and expand the Layers folder.

   Note: If you do not see the folder where you placed the exercise data, you will need to make a new connection to the root directory that holds the data.

3. Add ChinaPoly, ChinaUrbAgglomerations, HongKongMacau, and TaiwanUrbanAgglomerations.



4. Put ChinaPoly on top, right-click its name in the table of contents, and click Properties. Click the Symbology tab and then the Symbol box. Click the Hollow symbol. Click OK and OK again as you return to the map.
5. Uncheck HongKongMacau and TaiwanUrbAgglomerations, as we will work only with urban agglomerations on mainland China.
6. Right-click ChinaUrbAgglomerations, and select Open Attribute Table.
7. Click the Table Options button at the top left of the Table window, and choose Add Field.

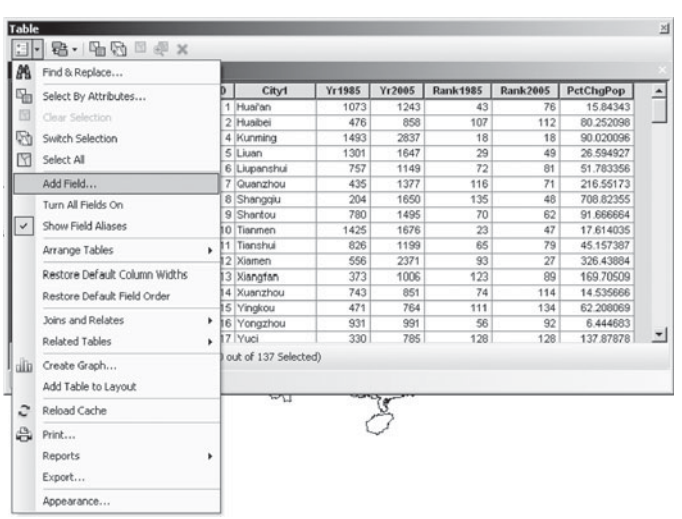
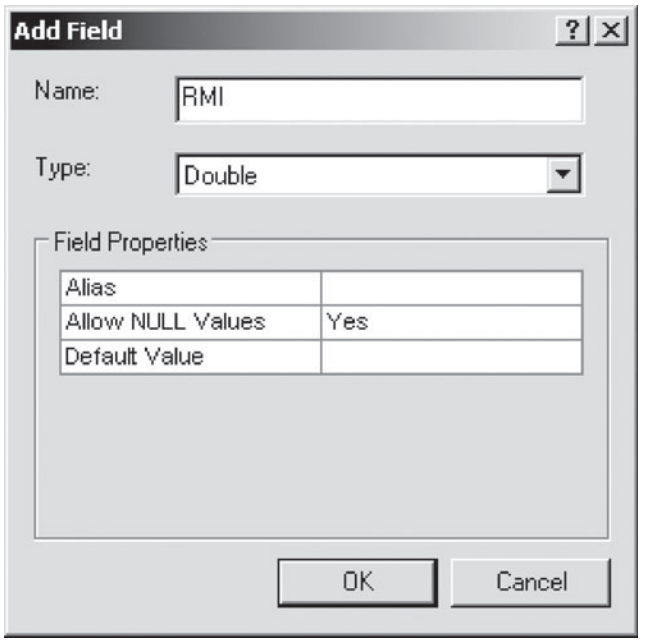
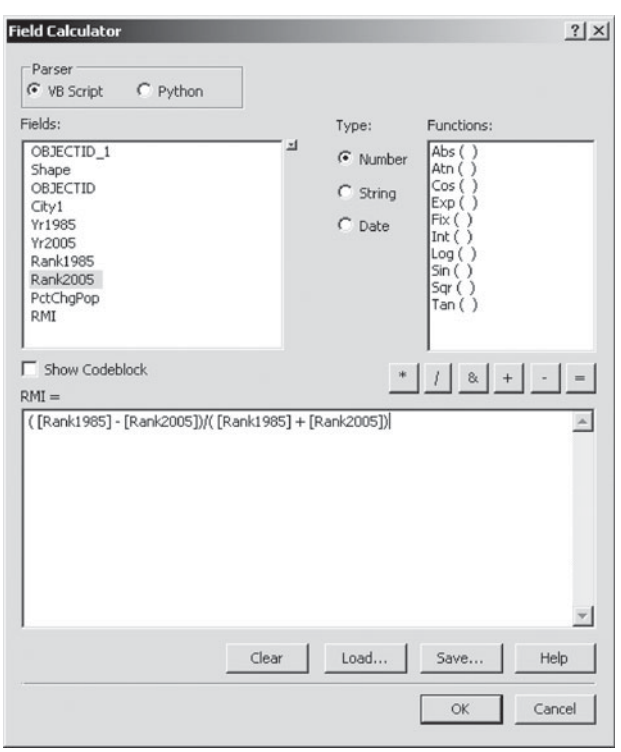


Table
Find & Replace...
Select By Attributes...
Clear Selection
Switch Selection
Select All
Add Field...
Turn All Fields On
Show Field Aliases
Arrange Tables
Restore Default Column Widths
Restore Default Field Order
Joins and Relates
Related Tables
Create Graph...
Add Table to Layout
Reload Cache
Print...
Reports
Export...
Appearance...
City1 Yr1985 Yr2005 Rank1985 Rank2005 PctChgPop
1 Hua'an 1073 1243 43 76 15.84343
2 Huaibei 476 858 107 112 80.252098
4 Kunming 1493 2837 18 18 90.020096
5 Liuan 1301 1647 29 49 26.594927
6 Liupanshui 757 1149 72 81 51.783356
7 Quanzhou 435 1377 116 71 216.55173
8 Shangqiu 204 1650 135 48 708.82355
9 Shantou 780 1495 70 62 91.666664
10 Tianmen 1425 1676 23 47 17.614035
11 Tianshui 826 1199 65 79 45.157387
12 Xiamen 556 2371 93 27 326.43884
13 Xiangfan 373 1006 123 89 169.70509
14 Xuanzhou 743 851 74 114 14.535666
15 Yingkou 471 764 111 134 62.208069
16 Yongzhou 931 991 56 92 6.444683
17 Yuci 330 785 128 128 137.87878
out of 137 Selected)

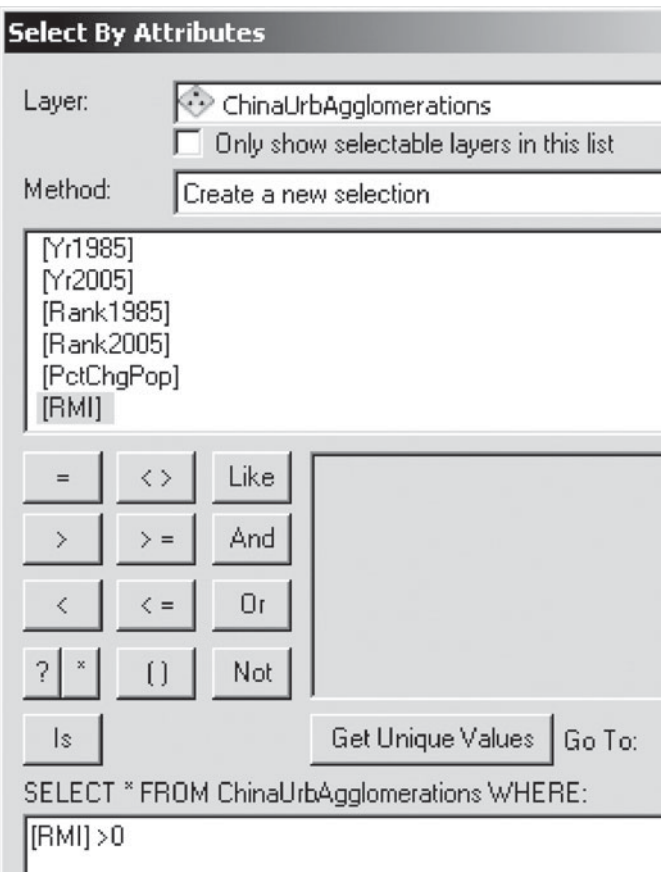
8. Add a field called RMI with a Type of Double, and click OK.



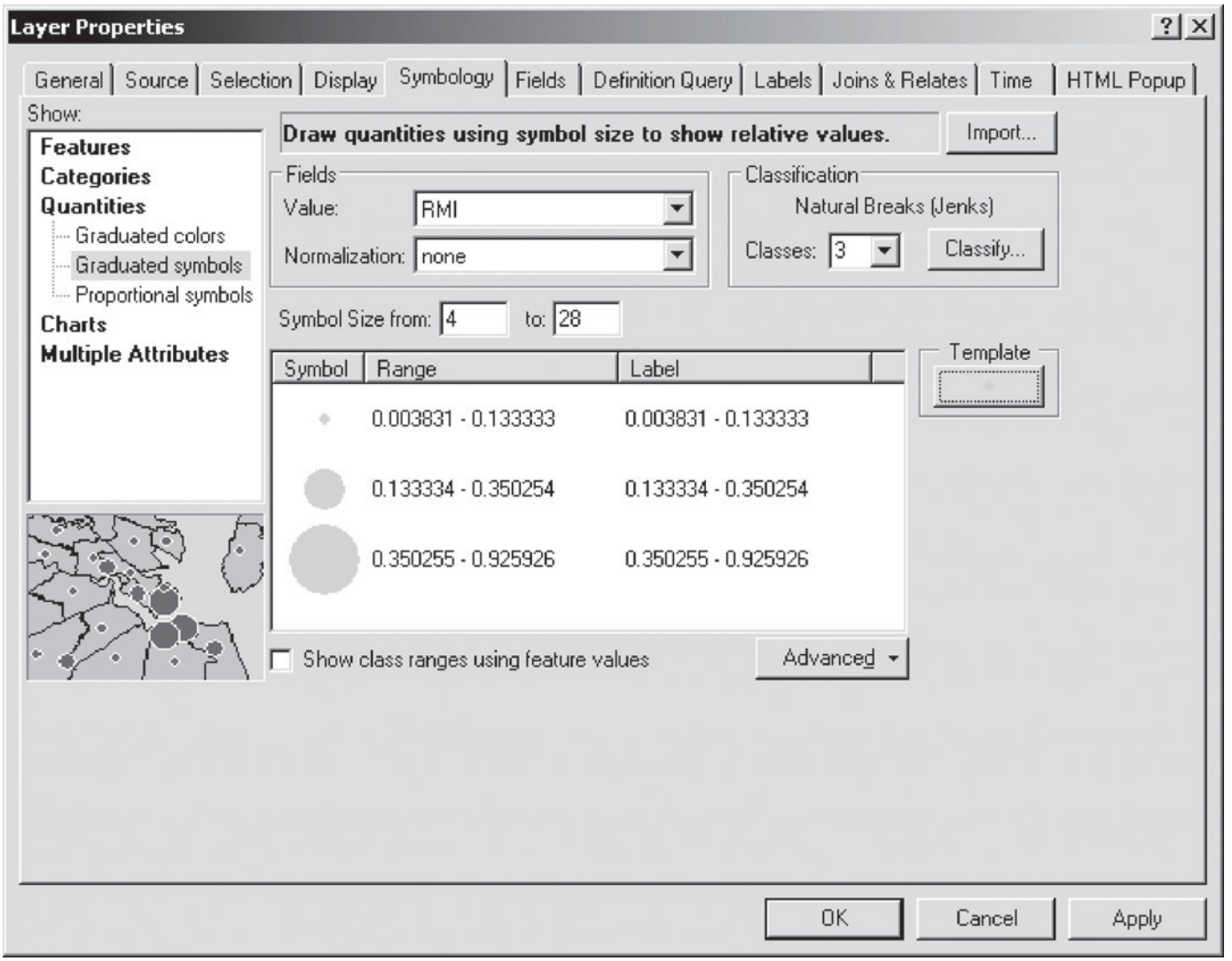
9. Select only the cities that changed rank in the 20-year period. Click the Select by Attributes button, and type Rank1985 <> Rank2005 (rank in 1985 not equal to rank in 2005). Click Apply and then Close. (If you do not do this before you run the RMI calculation in the next step, you will receive an error because you cannot divide by 0.)
10. Right-click the field heading RMI, and select Field Calculator. If you receive a box asking if you wish to continue, click Yes.
11. Compute RMI = ([Rank1985] – [Rank2005]) / ([Rank1985] + [Rank2005]). *Note:* "RMI=" is already entered for you in the calculation. You need to enter only the right side of the equation. Also note that you must type in parentheses around the numerator and denominator of the equation. Click OK.



12. Click the Clear Selection button, and close the attribute table.
13. Click Selection and Select By Attributes, set Layer to ChinaUrbAgglomerations, and enter [RMI] > 0 as the query statement. Click Apply and OK.



14. Right-click ChinaUrbAgglomerations, Data, and Export Data; call the new file IncreaseRMI.
15. Answer Yes to add the layer to the map.
16. Click Selection and Select By Attributes, set Layer to ChinaUrbAgglomerations, and enter [RMI] < 0 as the query statement. Click Apply and OK.
17. Right-click ChinaUrbAgglomerations, Data, and Export Data; call the new file DecreaseRMI.
18. Answer Yes to add the layer to the map.
19. Right-click ChinaUrbAgglomerations, and click Remove.
20. Right-click IncreaseRMI, Properties, Symbology, Quantities, and Graduated Symbols; under Fields, choose RMI as the Value to map, and change the number of Classes to 3. Make the Symbol Size range from 4 to 28. Click the color template, and change the color to a light red; then click Edit Symbol, and uncheck Use Outline. Click OK until the Layer Properties window is closed.



21. Repeat Step 20 above for the DecreaseRMI layer, but make the symbol light blue. Click the Symbol tab above the blue symbols, and select Flip Symbols so that the largest symbol is associated with the largest decreases in rank.

Symbol	Range	Label
	-0.418182 - -0.235294	-0.418182 - -0.235294
	-0.235293 - -0.110169	-0.235293 - -0.110169
	-0.110168 - -0.004082	-0.110168 - -0.004082

22. Add labels in light red for IncreaseRMI by right-clicking and selecting Properties and clicking the Labels tab. Check the box at the top to turn on labels, change the color from black to light red, and change the text size to 14.

23. Repeat the above for the DecreaseRMI layer, but make the color of the labels light blue.

24. Zoom to the southeastern portion of China, where most of the cities with increasing RMIs are located.

25. Select Layout View under View to compose a map for printing.

26. Click the Insert Menu to insert a legend. In the first dialog box, make sure that DecreaseRMI and IncreaseRMI are the only Legend Items (box on the right). For instance, for the other layers in the box on the right, select and use the arrows to push them over to the left column.

27. Click Next, erase the word "Legend," and replace it with "Rank Mobility Index."
28. Click Next on the next several dialog boxes, and click Finish.
29. Now double-click the selected legend. Click the Items tab, and in the right-hand column, double-click DecreaseRMI, click the Horizontal Single Symbol Layer Name and Label legend style, and then click OK. Double-click IncreaseRMI, click the Horizontal Single Symbol Layer Name and Label legend style, and then click OK. Click OK as you exit back to the map view. Reposition the map to a suitable spot.
30. Click the Insert Menu, and insert a title for the map.
31. Click File, select Export Map, change Type to pdf format, and save the map to a location you can find later so you can include the map with your report.
32. Save your map, and exit ArcMap.

ArcGIS 10 Short Essay: The economic growth of China over the past 25 years has been focused in its southern and southeastern regions, typified by the amazing expansion of the Shenzhen Special Economic Zone, which is just west of Hong Kong. Discuss the southern pattern you see in the Chinese RMI map. Also, discuss any other patterns you see related to RMI changes in China. Include mention of the cities that had RMIs of 0. Why did their ranks not change? Read the "Analyzing an Urban Issue" section of Chapter 2 for background on this topic.

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CHAPTER

5 Neighborhoods

Neighborhoods are the places in cities that people consider their communities. They are the residential areas in the fabric of cities that also provide social, cultural, and recreational outlets for people (see Figure 5.1). The boundaries of neighborhoods can be expressways, roads, or other physical limits, but they can also be defined by social and economic networks and therefore have been regarded by some as socially constructed entities (Suttles, 1972; Warf, 2006). The study of neighborhoods has been undertaken by many urban study disciplines, ranging from urban geography to social psychology. In addition to the question of what defines a neighborhood, research has examined such other issues as the social and economic health of neighborhoods and the changing characteristics of neighborhoods over time (Warf, 2006). A further issue, neighborhood vitality, not only has been of interest to urban scholars, but also is addressed daily by city administrators. The geographic approach to the study of neighborhoods has varied, but in recent decades, much attention has been paid to their definition, stability, conflicts, economic development, renewal, and identity.

Urban geography has advanced our knowledge of important neighborhood processes such as gentrification. Urban geographers have also extensively studied other processes such as the diffusion of race and ethnicity among and across neighborhoods. Neighborhood associations play an important role in the vitality of neighborhoods, so geographers have had to consider their spatial impacts as well. The concentration of poverty in extremely poor neighborhoods has received much attention, but at the same time, urban geographers have investigated such opposite phenomena as gated communities.

This chapter starts with a discussion of the neighborhood concept in general. A number of attempts have been made to delineate the urban neighborhood; however, the definition of a neighborhood is often subjective. Neighborhoods continue to be an important component of cities, as indicated by the continued strength of neighborhood identity. The attachment people show toward their neighborhood is a function of the quality of the neighborhood. Behavioral approaches to the study of neighborhoods have emphasized the role of activism and who is likely to become involved in the community. Many studies have confirmed that the higher their social and economic class, the more likely people are to become active in the neighborhood decision process. Such power concentrated among so few has proved to be detrimental for lower-income groups, who have not always had their community interests represented.

A Las Vegas case study later demonstrates that the spirit of community can even be created in the newest of urban landscapes. There are skeptics who argue that community institutions have broken down with the rapid pace of suburbanization. Neotraditional planning is one response to the loss of community, but strong evidence is presented in support of the presence of community, albeit different from traditional conceptions of community, in modern suburbia. A similar concern has been voiced about the rise of the gated community. The gated community is not only on the rise in America, but also rising rapidly in Chinese cities, as well as in the megacities of Latin America. Critics of gated communities fear further diminishment of community and the erosion of public space by the encroachment of private space.

The examination of change in the racial composition of neighborhoods has a long tradition in urban geography and related disciplines. With an early focus of research on White versus Black, racially integrated neighborhoods often used to be viewed as a temporary stage in the transition process from White to Black that would inevitably become entirely Black in some future time period. Early research tried to establish a statistical "tipping point" beyond

FIGURE 5.1 Downtown Barcelona neighborhood.

which the proportion of Blacks would rapidly increase and become a majority. Recent studies have questioned this deterministic racial succession assumption and argue that the rise of multiethnic neighborhoods refutes the process. The cause of the continued separation of races and ethnic groups in cities is hotly debated, with some arguing discrimination, whereas others suggest that it is due to own-race preferences by residents. The section "Analyzing an Urban Issue" looks at racial transitions for St. Louis for the 1990-to-2000 period, employing a Markov chain analysis in combination with a geographic information system (GIS).

Gentrification continues to be a prominent concept in the neighborhood change literature. The rent-gap explanation of gentrification is reviewed, and recent attempts to measure it are illustrated. The debate continues over what is the best explanation of the process, with economic, cultural, and consumer behaviors all playing a part. Urban researchers are addressing more aspects of gentrification, including its varied forms in the developing world. The last section considers the impact of the housing, mortgage, and credit crisis of 2007–2010 on U.S. neighborhoods. The crisis has not only been economically devastating, but also has increased human stress and suffering in those neighborhoods.

5.1 CONCEPT OF NEIGHBORHOOD

The concept of neighborhood is largely intuitive; if asked, most people could roughly define the geographic boundaries of their neighborhood. However, the concept itself lacks a succinct definition (Smith, 1985), so it is usually defined by the degree to which the people in the neighborhood have a sense of neighborhood identity. Martin (2003) contended that neighborhoods are a social product created through conflicting perspectives arising out of neighborhood activism. Haeberle (1988) noted that neighborhood definitions are addressed either subjectively by looking at the characteristics of the people or with a place-based approach that tries to demarcate the boundaries with physical features such as traffic arteries. Warf (2006) considers that today's neighborhoods reflect three classical dimensions for its residents: common socioeconomic level, similar stage in the family life cycle, and similar ethnicity. Although neighborhoods classically were viewed as places for personal and social interactions on a daily basis, today residents tend to be more isolated from each other, since they usually work elsewhere and can communicate with, drive to, and meet friends more easily outside the neighborhood. Ahlbrandt (1984) claimed relative success in the physical delineation of 78 distinct neighborhoods in Pittsburgh, a task he completed by holding workshops throughout the city where residents provided input on the boundaries (see Figure 5.2). The very hilly and broken terrain in Pittsburgh, as well as in other similar cities (e.g., Cincinnati and San Francisco), has a good deal to do with forming and preserving neighborhood identity (see Figure 5.3 on page 143).

Many current city neighborhoods were once separate incorporated places, such as Boston's Charlestown, Roxbury, and Dorchester, with names that are still in common use as neighborhood or area names. Big annexations like New York City's Brooklyn and Boston's Dorchester contain many separate neighborhoods, just as they did when they were separate. A sometimes-useful guide to neighborhood extent (and existence in local people's minds) is the local phone book. For instance, how many businesses use a neighborhood's name and how those businesses are distributed geographically can sometimes yield a useful neighborhood boundary.

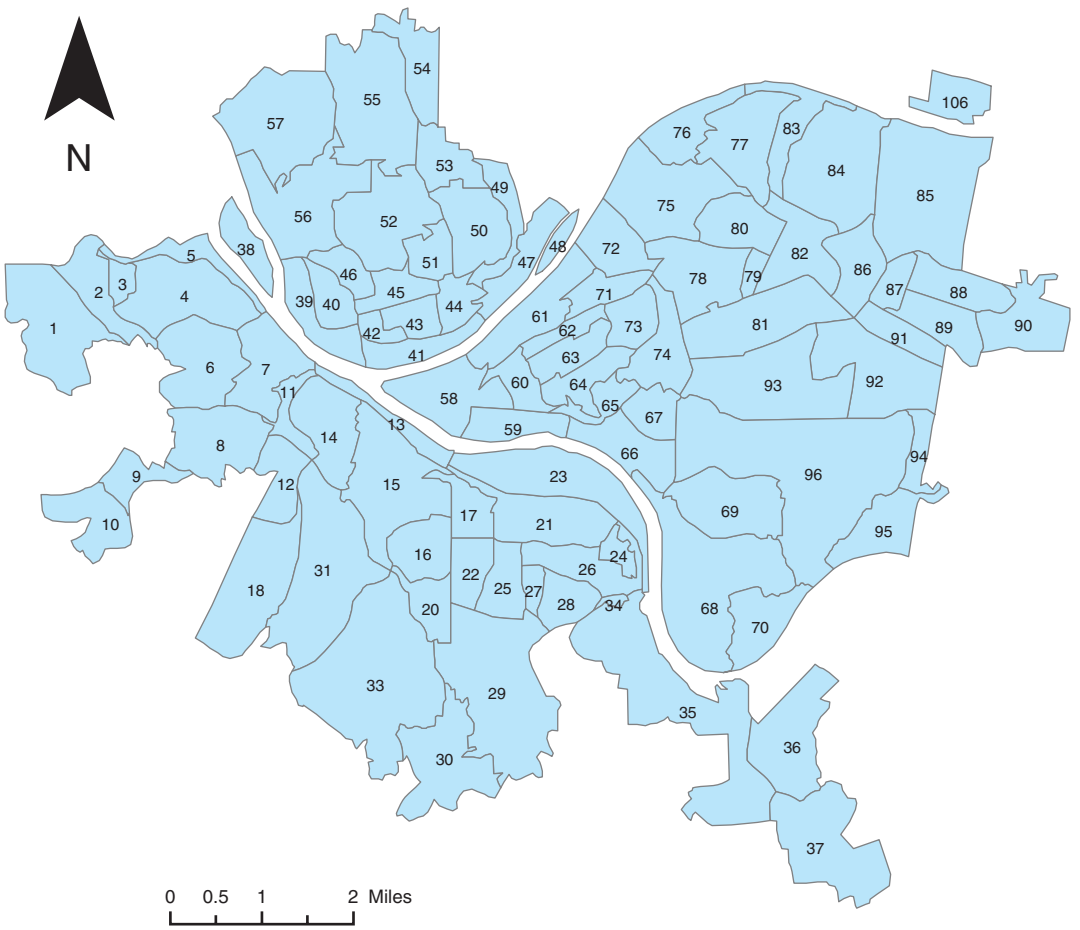
The importance of neighborhood identity cannot be underestimated. A number of city neighborhoods have at one time or another been widely known across America—for instance, Beacon Hill (Boston), Harlem (New York City), Over-the-Rhine (Cincinnati), Watts (Los Angeles), The Hill (St. Louis), Adams-Morgan (Washington, DC), Little Havana (Miami), and Back of the Yards (Chicago). On the issue of the differences in the structure and composition of urban neighborhoods, Ahlbrandt (1984) surveyed almost 6,000 residents living throughout Pittsburgh and addressed critical issues about neighborhoods, including attachment toward the neighborhood, social support systems, and urban policy implications. On the issue of attachment, the study addressed the relationship between participation in neighborhood activities and the quality of the environment. Neighborhoods that have high crime rates and lack basic services and other amenities will not attract much community participation. Participation, then, is to some extent a function of the neighborhood's quality of life, which Ahlbrandt depicted in a model of people's feelings about their neighborhood (see Figure 5.4 on page 143). Among other findings, Ahlbrandt (1984) showed that the neighborhood does not hold the same meaning for all groups in the city and that for some it is not even important. However, he found that the elderly, the impoverished, and households with children were more dependent on neighborhoods. In many cases, the impoverished feel despair over the prospects of their neighborhoods even in the best of times.

Ahlbrandt's (1984) study also addressed the idea that the well-being of people is linked to the neighborhood environment where they live, although he stopped short of suggesting a causative direction for the relationship (see Figure 5.5 on page 143). In a detailed analysis of a Minneapolis neighborhood, Smith (1985) examined whether social status or participation in neighborhood affairs was most important in determining one's sense of identity with a local neighborhood. She found that activism plays a more important role and that the households showing the strongest sense of attachment were those that were both high status and actively involved in neighborhood affairs (Smith, 1985, p. 431). A similar finding was made in Pittsburgh, where higher-income respondents were more likely to participate in voluntary organizations, whereas lower-income residents were less likely to interact with their neighbors (Ahlbrandt, 1984, pp. 22–23). Nevertheless, some case studies document local poor residents organizing to create change in their favor. One case, in particular, that has received national attention involved a Boston neighborhood revitalization effort dubbed the Dudley Street Neighborhood Initiative (DSNI), which was initiated by a trust company in 1984. The trust company sponsored a meeting to unveil its renewal and governing plan, but it was immediately confronted with concerns over the governing structure by some of the residents, one of whom, Che Madyun, a single mother of three, voiced it this way:

> I asked how many of the people up there [running the meeting] lived in the neighborhood. Not one. And then I asked, How can you say the residents are going to be represented? You always have people from downtown or somewhere else telling you what you need in your neighborhood. This is important: planning never happens without people who are going to have to live with the results day to day being involved, from the beginning. (Che Madyun, as quoted in Bright, 2003, p. 78)

Che Madyun was eventually elected DSNI board president in 1985 (serving through 1995), and 15 years later the Dudley Street neighborhood was considered a success by the planning and urban studies community, due in large part to resident control of the process.

In a study on Sun City West outside Phoenix, McHugh, Gober, and Borough (2002) showed how the wishes of higher-status households actively involved in community decision making can sometimes lead to detrimental effects for lower-income residents who are not well organized. Sun City West is located in the Dysart School District in northwest Phoenix, which is composed largely of Latinos of modest economic means (see



NUMBER	NEIGHBORHOOD	NUMBER	NEIGHBORHOOD	NUMBER	NEIGHBORHOOD	NUMBER	NEIGHBORHOOD
1	Fairywood	25	Mt. Oliver Boro	50	Spring Hill-City View	73	Upper Hill
2	Windgap	26	Arlington	51	Fineview	74	North Oakland
3	Chartiers City	27	Mt. Oliver	52	Perry South	75	Central Lawrenceville
4	Sheraden	28	St. Clair	53	Northview Heights	76	Upper Lawrenceville
5	Esplen	29	Carrick	54	Summer Hill	77	Stanton Heights
6	Crafton Heights	30	Overbrook	55	Perry North	78	Bloomfield
7	Elliot	31	Beechview	56	Marshall–Shadeland	79	Friendship
8	Westwood	33	Brookline	57	Brighton Heights	80	Garfield
9	Oakwood	35	Hays	58	Central Buisness District	81	Shadyside
10	East Carnegie	36	New Homestead	59	Bluff	82	East Liberty
11	West End	37	Lincoln Place	60	Crawford-Roberts	83	Morningside
12	Ridgemont	38	Brunots Island	61	Strip District	84	Highland Park
13	South Shore	39	Chateau	62	Bedford Dwellings	85	Lincoln–Lemington Belmar
14	Duquesne Heights	40	Manchester	63	Middle Hill	86	Larimer
15	Mount Washington	41	North Shore	64	Terrace Village	87	Homewood West
16	Beltzhoover	42	Allegheny West	65	West Oakland	88	Homewood North
17	Allentown	43	Allegheny Center	66	South Oakland	89	Homewood South
18	Banksville	44	East Alleghany	67	Central Oakland	90	East Hills
20	Bon Air	45	Central Northside	68	Hazelwood	91	Point Breeze North
21	Southside Slopes	46	California–Kirkbride	69	Greenfield	92	Point Breeze
22	Knoxville	47	Troy Hill	70	Glen Hazel	93	Squirrel Hill North
23	Southside Flatts	48	Herrs Island	71	Polish Hill	94	Regent Square
24	Arlington Heights	49	Spring Garden	72	Lower Lawrenceville	95	Swissheim Park
						96	Squirrel Hill South

FIGURE 5.2 Neighborhoods in the city of Pittsburgh, Pennsylvania.

FIGURE 5.3 Squirrel Hill neighborhood, Pittsburgh, Pennsylvania.

FIGURE 5.5 Housing abandonment in Detroit.

Figure 5.6). The Sun City West seniors, who are a minority in the district, were successful at defeating school funding measures and were able to initiate a plan to secede from the district to avoid paying future taxes for the schools (McHugh et al., 2002, p. 639).

A case study of the evolution of neighborhood identity in Las Vegas illustrates that the process continues even in the newest of urban landscapes (Gottdiener, Collins, & Dickens, 1999). Las Vegas might be the last place one would look for the emergence of community or neighborhood identity, in part because it is often showcased as America's most popular resort city. The metropolitan area of Las Vegas–Paradise in 2007 included 1.84 million people, most of them living in recently built communities, and so provides an excellent test case of how "sense of community" plays out in a growth area.

The first condition for a successful community is residential permanency, which began to occur in volume in Las Vegas in the 1980s. The process of community formation, however, occurred in large part because most of the new housing was built in master-planned communities (Gottdiener et al., 1999, p. 128). Although master-planned communities were introduced early in Las Vegas history, the concept flourished with the 1975 Green Valley Project, located south of the Strip in suburban Henderson. The project involved 1,000 acres, divided into 10-acre subdivisions. A master-planned community in a suburb of Las Vegas is seen in Figure 5.7 on page 145. In the mid-1980s,

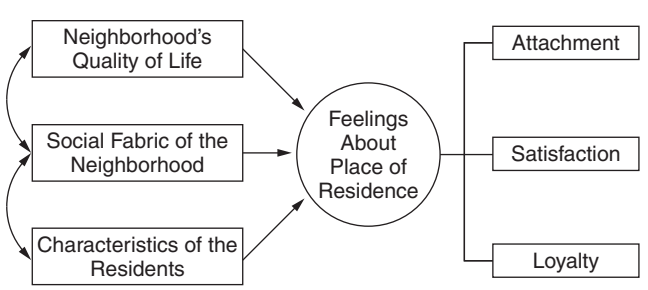


FIGURE 5.4 Ahlbrandt's model of neighborhood perception: People's feelings about place of residence. *Source:* Albrandt, Roger S. 1984. "Neighborhoods, People, and Community." New York: Plenum Press. Diagram. "Model of neighborhood perception: people's feeling about place of residence." Reprinted by permission.

as the region's economy was booming and diversifying, middle-class professionals were drawn to the Green Valley subdivisions. The new residents were attracted by walking trails, imported vegetation, a recreation center, new schools, a shopping center, and many parks (Gottdiener et al., 1999, pp. 133–134). Green Valley was eventually built out, accommodating 30,000 residents. The remaining land was divided into sections to be developed with their own village centers. To many, Green Valley became a successful community with its own unique identity: "To its residents the address connotes an upscale, family-oriented community called Green Valley, not the gambling and tourist mecca 15 miles to the northwest" (Gottdiener et al., 1999, p. 138).

Summerlin, the second master-planned community developed in the Las Vegas region, fits more the full profile of a common interest development (CID). In a CID, the owner not only owns a housing unit, but also possesses rights to common features and amenities of the development that would likely be too costly for a single owner to own. Examples are community associations, homeowner or condo associations, cooperatives, timeshares, and planned unit developments. Modeled after the Irvine Ranch in southern California, the Summerlin community is located on the western rim of the Las Vegas Valley and is three times the size of Green Valley. The development of Irvine Ranch in Orange County, California, helped stimulate rapid growth in the county's largest city, Irvine, in the 1970s and 1980s, but its influence in matters of planning extended well beyond Orange County, as discussed in Chapter 11. The first Summerlin property to develop was the Del Webb retirement community Sun City (Gottdiener et al., 1999, p. 143). As is typical of CIDs, Summerlin started out fairly homogenous and had a number of covenants, conditions, and restrictions (CC&Rs) that limited the types of alterations that could be made to properties. However, Summerlin, with a deliberate marketing campaign, was able to diversify by attracting families and young professionals with a village concept that emphasized mixed uses with lots of common space devoted to golf courses: "With more than 7,700 homes and a population of 14,000 when sales closed in 1998, Sun City Summerlin was the first area in the city of Las Vegas where golf carts were authorized street vehicles" (Gottdiener et al., 1999, p. 144).

The Green Valley and Summerlin case studies by Gottdiener et al. (1999) illustrate that community functions do appear in new

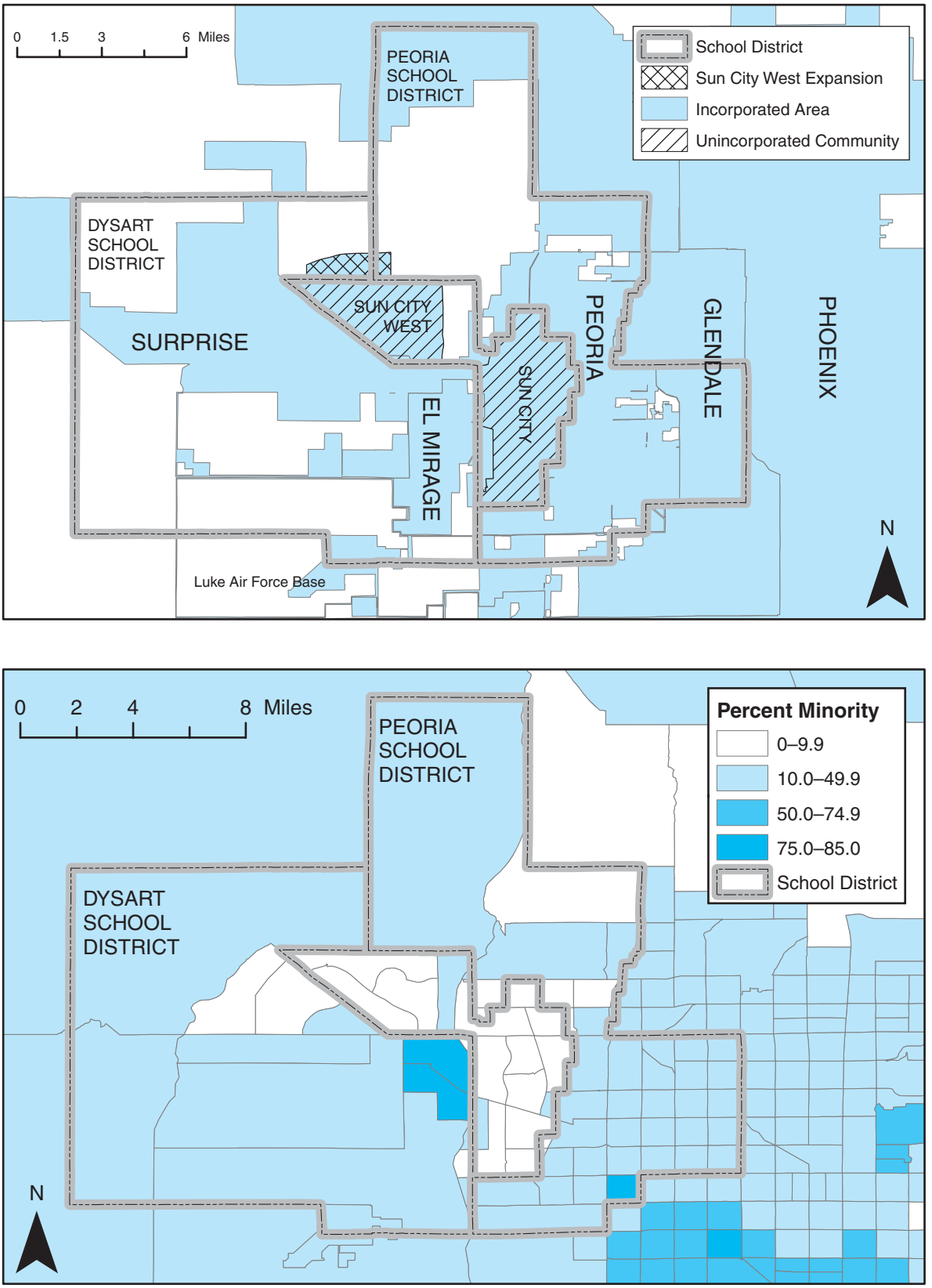


FIGURE 5.6 (a) Boundaries of Dysart and Peoria School Districts, Arizona, 2000. (b) Minority population percentages, Dysart and Peoria School Districts, 2000. *Source:* McHugh, Kevin, P. Gober, and D. Borough. 2002. "The Sun City Wars: Chapter 3." URBAN GEOGRAPHY 23(7):627–648. © Bellwether Publishing, Ltd. Reprinted by permission. Figure 3. P. 635 and Figure 5. P. 637.

FIGURE 5.7 Suburban development near Las Vegas.

or newly developed urban settlements. In comparing the modern community with the community of the past, it is frequently claimed in the popular media that those in the past were more appealing and functional with respect to providing a "sense of place." These sentiments toward neighborhoods of the past are often seen as nostalgic reactions to earlier community institutions that are claimed by Putnam (2000) to have anchored a community. Similar claims made by the "New Urbanists" have linked "sense of community" to urban design, and they have helped maintain interest in the neighborhood as a planning unit (Madanipour, 2001). Clark, Lloyd, Wong, and Jain (2002, p. 500) noted in a comment about gentrification that "the important local amenities are no longer schools, churches, and neighborhood associations, as in the urban mosaic of the Chicago School." Similarly, the most important new community institutions for the master-planned communities of Green Valley and Summerlin might, in fact, be recreational centers and golf courses.

5.2 SOCIAL LIFE IN THE CITY AND URBANISM AS A WAY OF LIFE

Urban sociologists have a long tradition of examining lifestyles in cities, which is taken to mean the "patterned ways of living that distinguish people in the urban arena" (Macionis & Parrillo, 1998, p. 214). There are several key characteristics that help define these lifestyles, including social class, age, gender, race, and ethnicity. The topics of race, ethnicity, and gender are taken up separately in Chapter 7. However, the topic of lifestyles in the city is important enough to devote a section to two of the developers and leading thinkers on the topic, Louis Wirth and Herbert Gans.

Louis Wirth, a University of Chicago sociologist, wrote a classic essay on the topic of lifestyles in the city titled "Urbanism as a Way of Life" (Wirth, 1938). His perspective was pioneering at the time, as he suggested that the city shapes lifestyles. The exceptionally high population densities of cities result in a new type of behavior. In particular, residents become rational, self-interested, specialized, reserved, and more tolerant (Macionis & Parrillo, 1998). Relationships in the city are much more functional as opposed to being less structured in rural settings. The city stimulates invention, innovation, and democracy. On the other hand, he considered urbanism lowers social ties, reduces social solidarity, and weakens kinship relationships. Merton (1968) extended Wirth's concept of the cosmopolitan lifestyle by introducing the term *local* to encapsulate the opposite type of lifestyle. The life of the localite is centered on an immediate geographic area with social interaction limited to that area, whereas the cosmopolites are more footloose and open to a wider range of social interactions.

Herbert Gans, a sociologist mostly at Columbia University, would later challenge Wirth's ideas on lifestyle and the extensions such as that offered by Merton (Rosen, 2010). In particular, Gans

(1968) argued that it is not the city that produces the cosmopolite and the localite; rather, the city is diverse and made up of both and a variety in between. This diversity, according to Gans, was a product of other factors, including class, age, and gender. To illustrate his view, Gans developed a four-part typology of urban lifestyles:

1. ***The Cosmopolites.*** This was a lifestyle similar to that identified by Wirth to capture the sophisticated urban resident.
2. ***The Unmarried or Childless.*** This lifestyle, which often overlaps with the cosmopolite category, consists of single adults or couples without children living in city apartments. Today, some refer to this group as yuppies (young urban professionals) or dinks (dual income, no kids).
3. ***The Ethnic Villagers.*** These lifestyles are exhibited by some ethnic groups that have not shed their cultural heritages and that maintain their homeland lifestyle in ethnic enclaves in the city. Gans (1962) had explored ethnic lifestyles of Boston's West End neighborhood in his book *The Urban Villagers*.
4. ***The Deprived and Trapped.*** These lifestyles are exhibited by those caught in a cycle of poverty in the city. They are often left with no choice but to live in the most dilapidated housing stock of the city.

Gans recognized that this was not an exhaustive list of urban lifestyles. In fact, he would argue exactly that as a way to dismiss Wirth's idea that the city produces a uniquely urban lifestyle.

5.3 GATED COMMUNITIES

Gated communities are neighborhoods that physically restrict access by the general public with walls or fences and admission only through gates (see Figure 5.8). The number of Americans living in gated communities is estimated at 16 million (Pouder & Clark, 2009). There are many types of gated communities, and the residents who live in them do so for a variety of reasons (Blakely & Snyder, 1998, 1999). The motives often include protection from crime, feelings of prestige, and desire for privacy. Blakely and Snyder (1998) identified three major types of gated communities:

1. ***Lifestyle Communities:*** Country clubs and retirement developments emphasizing extensive recreational facilities such as golf courses.
2. ***Prestige Communities:*** Standard urban subdivisions developed with gates to enhance status.
3. ***Security Zone Communities:*** Existing communities that have gates added by the residents to control crime and traffic.

Gated communities (Figure 5.8) have been around for a long time, taking on a variety of forms. However, the concept grew in popularity with the advent of master-planned retirement communities in the 1960s and 1970s (Blakely & Snyder, 1999). The concept then spread to resorts, to country clubs, and eventually to middle-class suburbia. The rise of gated communities is attributed to the rise of disposable income among the

FIGURE 5.8 Gated community in the suburbs. *Source:* Woodfin Camp & Associates.

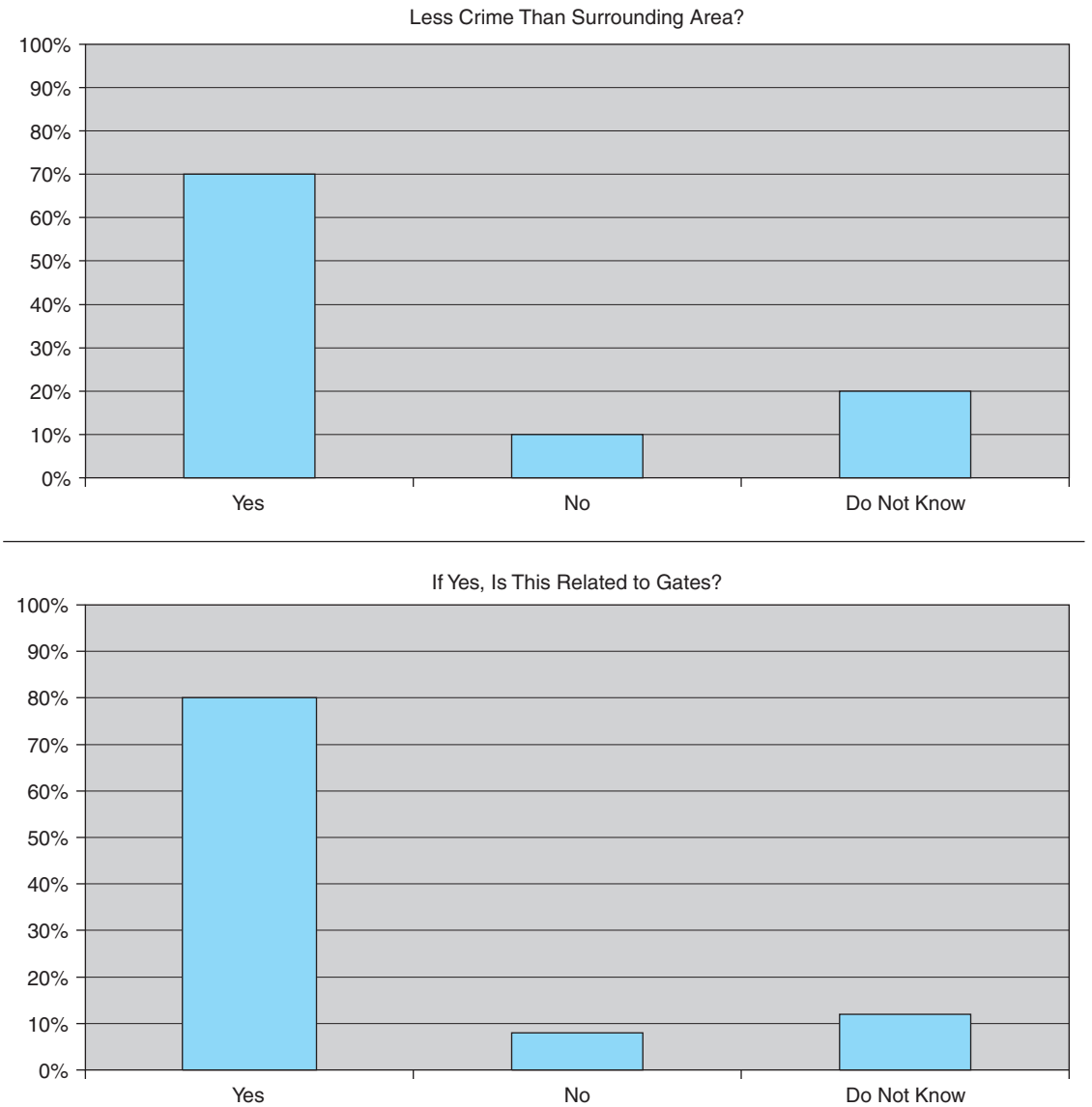


FIGURE 5.9A Perceptions of the level of crime in gated communities: question responses from gated community residents. *Source:* Blakely, Edward J. and M.G. Snyder. 1998. "Forting up: Gated communities in the United States." JOURNAL OF ARCHITECTURAL AND PLANNING RESEARCH 15:61–72. Reprinted by permission of Locke Science Publishing Company, Inc. Figures 1 and 2. Graphs of Survey of Gated Communities.

middle and upper middle classes—and the resulting wish to have their neighborhoods designed to symbolize their status (Blakely & Snyder, 1998). Gated communities have undergone huge growth in the United States, Latin America, and South Africa and have increased in Europe (Atkinson & Blandy, 2005).

Blakely and Snyder (1998) measured two aspects of gated community perception by their residents, crime and community spirit (see Figure 5.9). The perception that gates increase security was strong, and most residents of gated communities found their neighbors to be friendly. Luymes (1999) developed a typology of access control and perimeter control that classifies gated communities based on their perceived security and neighborhood status (see Figure 5.10 on page 149). He found that the typology of control is often established along socioeconomic lines, with the most affluent gated communities having the securest of walls and existing within a larger gated community with 24-hour security (Luymes, 1999, p. 199).

Webster (2001) referred to the occupants of gated communities as the "club realm" and argued that the class is here to stay and will even grow. Therefore, developers and government planners should work with the concept. Webster reviewed the leading works on gated communities and noted two viewpoints with respect to this growing trend. The first is an anti-gate perspective seen in its extreme in Davis's (1990) *City of Quartz,* which decries what he saw as a growing privatization of exclusive residential space in Los Angeles. The other extreme is represented by Foldvary's (1994) *Public Goods and Private Communities,* in which he used neoclassical economics to argue that gated communities represent a more efficient mode of urban development. However, the critics of this increasingly popular form of community seem to outnumber those in favor of the trend. Le Goix (2005) observed that there is a natural blending of interests between developers of gated communities and local governments, since the higher valuations often associated with the

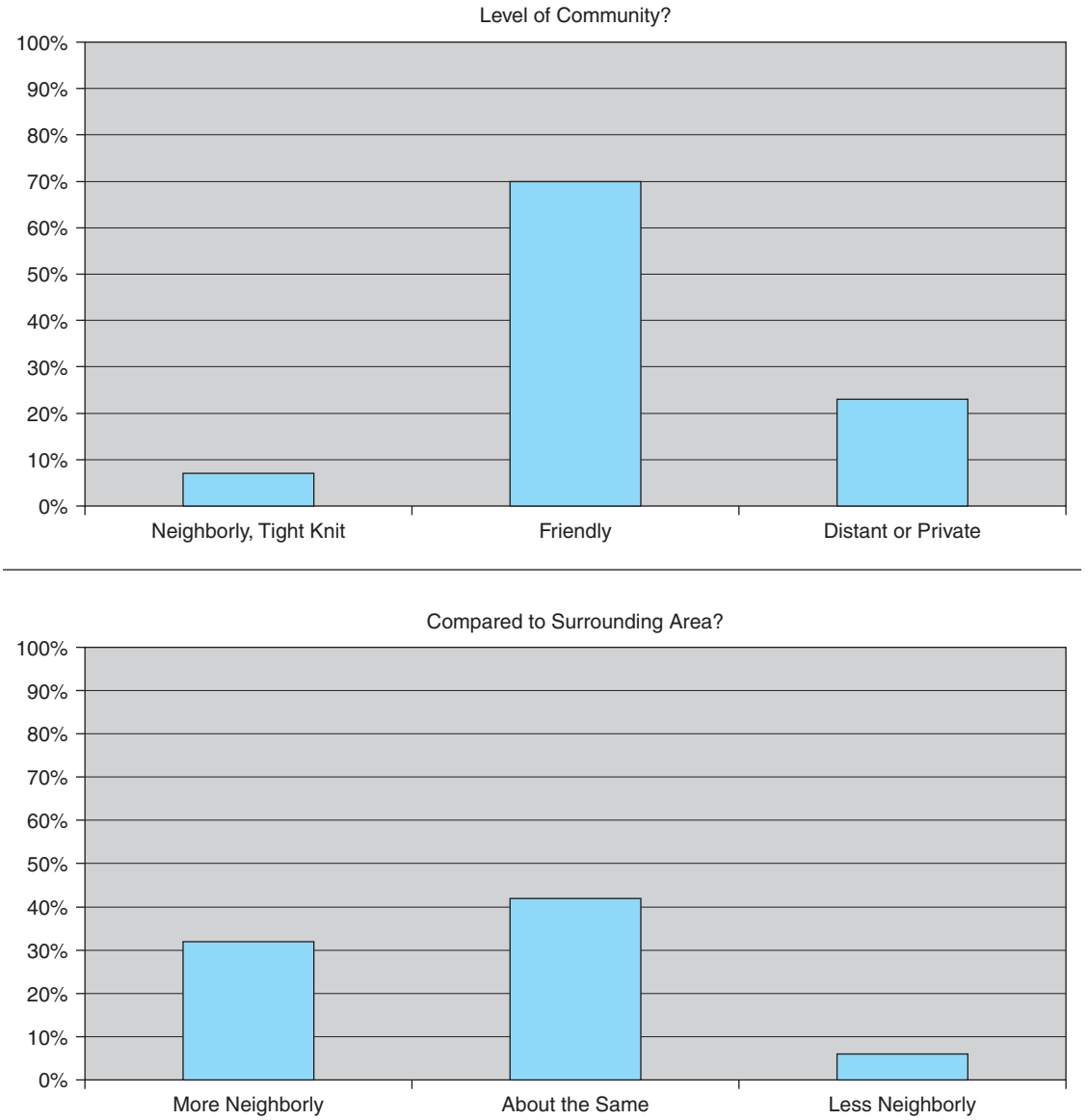


FIGURE 5.9B Level of community feeling in gated communities: question responses from gated community residents. *Source:* Blakely, Edward J. and M.G. Snyder. 1998. "Forting up: Gated communities in the United States." JOURNAL OF ARCHITECTURAL AND PLANNING RESEARCH 15:61–72. Reprinted by permission of Locke Science Publishing Company, Inc. Figures 1 and 2. Graphs of Survey of Gated Communitie.

communities increase local property tax revenues in many localities. On the other hand, the "exclusivity" of gated communities is considered by many to be contrary to the broader social and economic equity underlying federal and state support to cities and communities (Atkinson & Blandy, 2005). Another concern is that gated communities siphon off affluent persons and families, so the "residual" neighborhoods they leave are less economically diverse and less prosperous.

Cities of the southwestern United States have the largest number of such communities. For instance, southern California had an estimated 80,000 housing units in gated communities in 2000, while in 2001 gated communities made up 12 percent of the southern California market for new homes, with Orange County at 21 percent and Palm Springs and surrounding communities at 50 percent (Le Goix, 2005).

Gated communities have grown and spread in Las Vegas, but sometimes with controversy (McKenzie, 2005). In the case of the formerly ungated neighborhood of Bonanza Village, older, often retired original residents were resistant to young, hip newcomers seeking to "gate" the community. The community was sharply divided on the issue, but eventually the city of Las Vegas threw its weight behind the "gating" advocates. In spite of lawsuits from outraged original residents that went to the Nevada Supreme Court, Bonanza Village was converted in 2001 into a gated community through the city's influence and with the eventual use of eminent domain to build a wall (McKenzie, 2005).

The gated community idea has spread beyond the United States into parts of the developing world. Miao (2003) observed a sharp increase in gated communities in

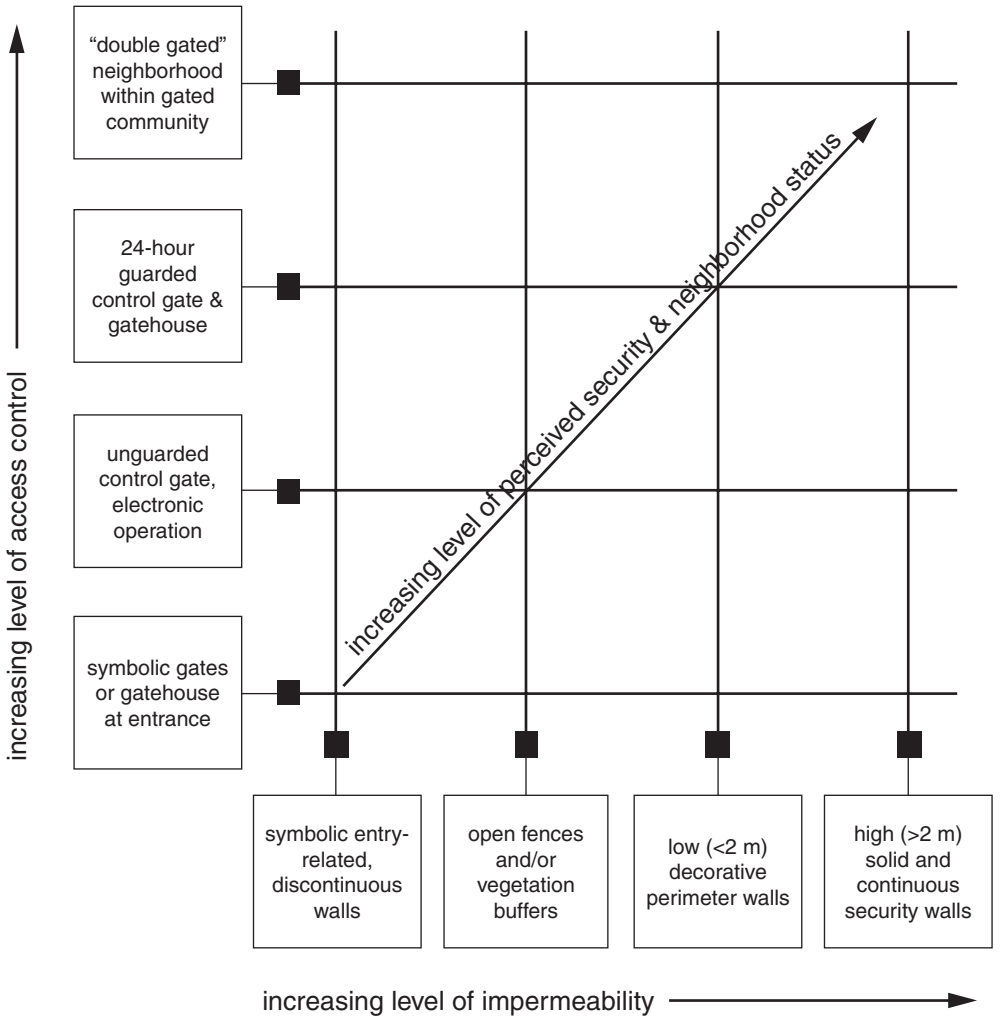

"double gated" neighborhood within gated community
24-hour guarded control gate & gatehouse
unguarded control gate, electronic operation
symbolic gates or gatehouse at entrance
increasing level of access control
increasing level of perceived security & neighborhood status
symbolic entry-related, discontinuous walls
open fences and/or vegetation buffers
low (<2 m) decorative perimeter walls
high (>2 m) solid and continuous security walls
increasing level of impermeability

FIGURE 5.10 Typology of gated communities. *Source:* Luymes, Don. 1999. "The fortification of suburbia: investigating the rise of enclave communities." LANDSCAPE AND URBAN PLANNING 39:187–203. Copyright 1999, reprinted with permission from Elsevier. Figure 5. P. 198. "A typology of enclave neighborhoods, organized around the variables of the level of access control (gates), and the level of perimeter impermeability (walls), showing the relationship between these designed control systems, perceived security status."

Chinese cities after the 1978 economic reform (see Figure 5.11). Gated communities serve not only the upper and middle class in China, but also all income levels. The government advocates gated communities because of their perceived role in controlling crime, which in effect contributes to stability (Miao, 2003, p. 49). Pow (2007) reports on confrontations in Shanghai between a gated enclave developed by the private sector and the government. For instance, when the Shanghai government approved the placement of numerous shops open to the public within the gated Shanghai Spring City, strident protests ensued from residents, citing "loss of exclusivity and neighborhood security" (Pow, 2007, p. 1539). This echoes the contention in the U.S. gated communities. Although Shanghai's gated communities attract the affluent and form a contrast with less-well-off surrounding neighborhoods, Pow (2007) observed that parties in favor of gated enclaves reason that they represent "civilized modernity" and a higher morality in contrast to rougher rural ways, rather than arguing blatantly about class and wealth differences.

Gated communities are also increasing in Latin American megacities, including on the outskirts within large edge-city-like projects (Coy & Pohler, 2002). As in other places, they are being built for their perceived benefit of security; however, according to Coy and Pohler (2002, p. 366), they are forming islands of prosperity in a sea of poverty, increasing the already deep division between the upper class and the rest of the people. Echoing a similar concern of economic polarization in the United States, Diamond (2005) stated: "If conditions deteriorate too much for poorer people, gates will not keep the rioters out. Rioters eventually burned the palaces of Maya kings and tore down the statues of Easter Island chiefs; they have also already threatened wealthy districts in Los Angeles twice in recent decades" (p. A21).

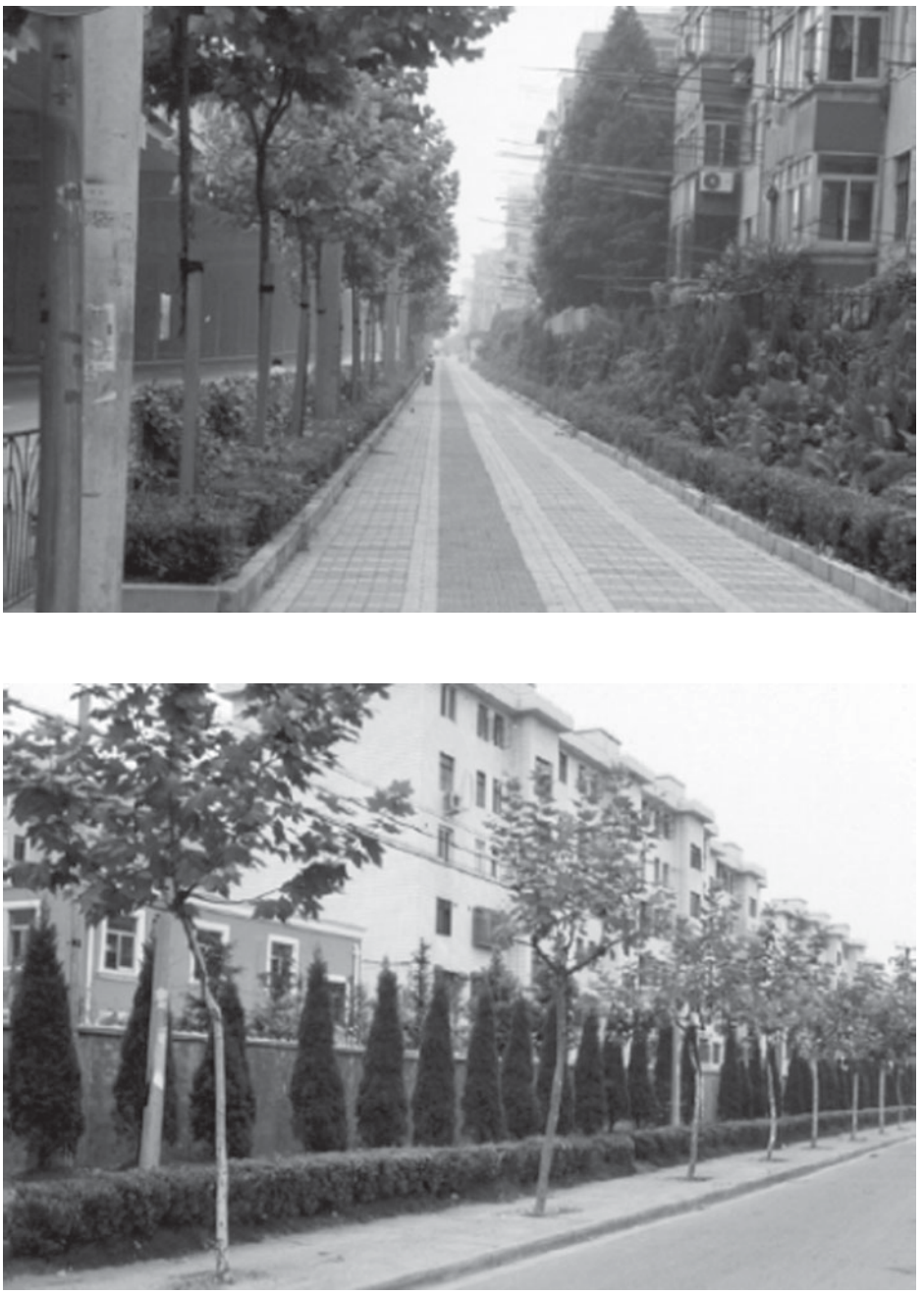


FIGURE 5.11 Gated communities in suburban Shanghai. *Source:* Miao, P. (2003). "Deserted streets in a jammed town: The gated community in Chinese cities and its solution." *Journal of Urban Design* 8:45–66, Figure 1. Sidewalks next to gated communities in suburban Shanghai, p. 46.

5.4 CHANGE IN NEIGHBORHOOD RACIAL COMPOSITION

There is a long tradition in urban geography and sociology of examining the change of inner-city neighborhoods from White to Black as Whites moved to newer areas or to the suburbs (Clark, 1993). The transition from White to Black neighborhoods is often described as a *racial succession,* a term that applies to any neighborhood change of racial composition. Colloquially, the process was referred to as "White flight," especially by those directly affected. The term *tipping point* was introduced to measure the critical proportion of Blacks in a neighborhood beyond which it would rapidly change from mixed to majority Black (Goering, 1978).

"White flight" is still in use today; however, with Black suburbanization increasing in the 1980s through the 2000s, some now position the issue as one of class, rather than race. Some studies have provided evidence contradicting the assumption

that racially mixed neighborhoods will inevitably tip in the direction of becoming more Black over time (Ottensmann, Good, & Gleeson, 1990). Wood and Lee (1991) drew similar conclusions after examining Los Angeles, where they noted an increase in multiethnic neighborhoods with combinations of White, Hispanic, Black, and Asian residents (see Figure 5.12). Clark (1993) also analyzed the data for Los Angeles; although he found some evidence of the multiethnic trend identified by Wood and Lee (1991), he also found an ample number of cases that fit the traditional invasion and succession model of neighborhood change, such as the change from Black to Hispanic census tracts.

A study of six very diverse Chicago neighborhoods indicated that most residents had positive feelings about living in a diverse neighborhood. Even though tensions were present, such as those between residents and small business owners, there was recognition that stability could be achieved with sufficient effort (Talen, 2010). Residents mostly wanted to maintain the status quo and were resistant to neighborhood change. Others have pointed to negative and destabilizing aspects of diverse neighborhoods, including heightened racial prejudice (Wilson & Taub, 2006) and social isolation (Putnam, 2000).

In a study of immigrant gateway cities, Clark and Blue (2004) found that integration is greater at higher education levels and that suburban areas were more integrated than urban cores. Johnston (2003), using data from the 2000 Census, showed that cores of extreme segregation remain in Los Angeles, despite some reduction in purely White and purely Black areas.

FIGURE 5.12 Optical shop in Chinatown in Seattle.

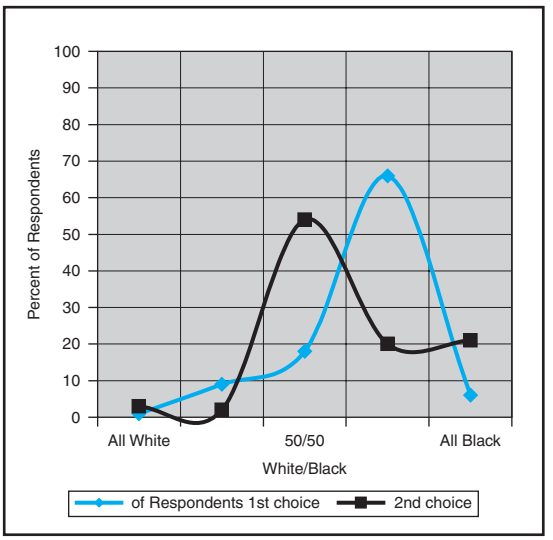
Another stream of literature on racial transitions in neighborhoods addresses the causes for continued separation of races. At one extreme are those that attribute the process to discrimination in a variety of forms, such as Farley, Fielding, and Krylsa (1997), whereas at the other extreme are those that argue for own-race residential preferences, such as Clark (2002). Clark saw continuing evidence of very strongly held own-race residential preferences as the most probable cause for racial and ethnic groups showing a continued bias toward separation. Examining results on residential preference by race in four cities, Clark (2002, p. 247) found that on their first choice Blacks opt for a more integrated neighborhood, but he gave higher credence to their second choice, for a less integrated neighborhood, which shows that in all of the cities the leaning is toward own-race residential areas (see Figure 5.13). The findings were also consistent for Whites, Hispanics, and Asians, leading Clark (2002) to refer to the preference for own-race residential areas as ethnocentrism. Such a motive stands in stark contrast to motivations attributed to discrimination.

Meanwhile, others contend that it is not choice, but discrimination that continues to play a major role in the separation of the races. *Redlining* is a process where lending institutions refuse to loan in a specific area due to perceived mortgage risk. It is the best-documented form of discrimination, resulting in the separation of races as far back as the 1930s (Harris & Forrester, 2003). Cohen (2003) found evidence of redlining by examining Veterans Administration home loans granted in four New Jersey counties between 1945 and 1960. She found that by 1960 the residents of the racially diverse Hudson County had received only $12 of mortgage insurance per capita, compared to the $601 per capita received in Nassau County, home to suburban Levittown and Garden City (Cohen, 2003, p. 205). Looking for more current forms of discriminatory practices, Cashin (2004) examined the movement of upper-middle-income Blacks to suburban Black enclaves, and she argued that they are still being steered to these enclaves by real estate agents. She pointed to more subtle legal practices than redlining, such as zoning laws and building codes, which perpetuate racial and class segregation.

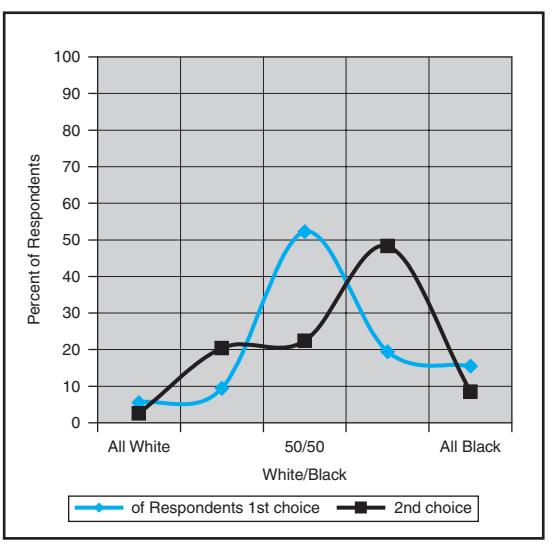
5.5 ANALYZING AN URBAN ISSUE: RACIAL SEGREGATION

The GIS exercise at the end of this chapter is designed to measure change in the Black neighborhoods in the St. Louis area between 1990 and 2000, using Markov chain analysis. To apply this methodology, it is first necessary to classify the neighborhoods (census tracts) of the St. Louis area into categories or "states" of Black neighborhoods—for instance, neighborhoods with low, moderate, and high proportions of Blacks. In the exercise, three states of Black census tracts are chosen: high (90–100 percent), medium (10–89 percent), and low (0–9 percent). The selection of these state thresholds was based on the observation that there were many more census tracts in the

A	Atlanta	
split	1st choice	2nd choice
1 All White	3	1
2	2	9
3 White/Black	54	18
4	20	66
5 All Black	21	6
Total	100	100



B	Boston	
split	1st choice	2nd choice
1 All White	5	2
2	9	20
3 White/Black	52	22
4	19	48
5 All Black	15	8
Total	100	100



C	Detroit	
split	1st choice	2nd choice
1 All White	2	3
2	6	10
3 White/Black	59	22
4	10	61
5 All Black	2	4
Total	79	100

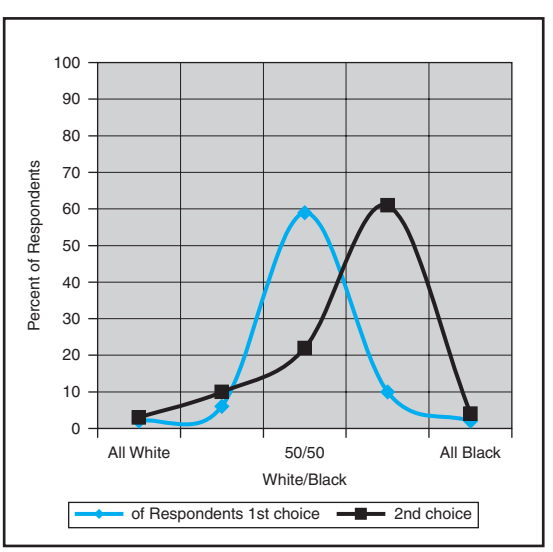


FIGURE 5.13 First and second preferences for neighborhood composition by Black residents. *Source:* Clark, William A.V. 2002. "Ethnic preferences and ethnic perceptions in multi-ethnic settings." URBAN GEOGRAPHY 23(3):237–256. © Bellwether Publishing, Ltd. Reprinted by permission. Figure 4. P. 247. "Percent of Black preferences for White neighborhoods in Atlanta(A) Boston (B) Detroit (C), and Los Angeles (D)."

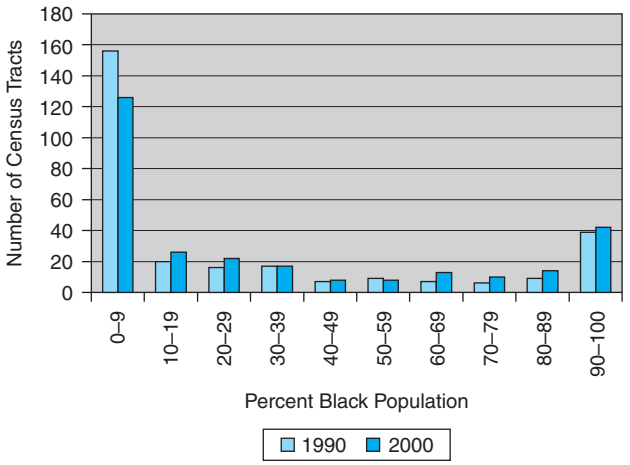


FIGURE 5.14 Percentage of Black population in census tracts in St. Louis City and St. Louis County. *Source:* 1990 U.S. Census and 2000 U.S. Census.

upper 10 percent and lower 10 percent than there are in the middle of the range (see Figure 5.14).

Having established the three types of Black neighborhoods, we now return to the question of how neighborhoods move from one state of Black proportion to another. A number of techniques can be used to quantify the changes in characteristics of neighborhoods through time, but a Markov chain has both descriptive and predictive properties that are especially appropriate for the analysis of neighborhood change (Bourne, 1971; Clark, 1965; Greene, 1994; Hunter, 1974). The Markov analysis is then applied to the three states derived from 1990 and 2000 census tract distributions in the St. Louis area. Next an examination is made of every two-state combination (e.g., low-to-low Black) for the 1990-to-2000 transition period.

As a result, a total of 9 two-state combinations are converted into a probability matrix of the following form:

		2000 State of Percentage Black			
		(1) Low	(2) Medium	(3) High	Total
1990 State of Percentage Black	(1) Low	P_{11}	P_{12}	P_{13}	1.0
	(2) Medium	P_{21}	P_{22}	P_{23}	1.0
	(3) High	P_{31}	P_{32}	P_{33}	1.0

where P_{11}, the first cell, represents the probability of a neighborhood starting the period in 1990 with a low percentage of Blacks and ending the period in 2000 with a similarly low percentage of Blacks. Cell entries in the matrix are calculated by the relative frequency definition of probability:

$$P_{ij} = \frac{f_{ij}}{\sum_{j=1}^{3} f_{ij}}$$

where P_{ij} represents the probability of a neighborhood moving from one percentage-Black level to another, f_{ij} is the observed number of transitions from state i to state j, and 3 is the number of states in this example.

The results of the counted transitions are entered into the matrix:

$P =$

	(1) Low	(2) Medium	(3) High	Total
(1) Low	124	33	0	157
(2) Medium	2	84	5	91
(3) High	0	1	37	38

Using the relative frequency definition of probability, we calculate:

		2000 State of Percentage Black			
		(1) Low	(2) Medium	(3) High	Total
1990 State of Percentage Black	(1) Low	.79	.21	.00	1.0
	(2) Medium	.02	.92	.06	1.0
	(3) High	.00	.03	.97	1.0

We find a low probability (.06) that a tract with a medium percentage of Blacks will transition to one with a high percentage. In fact, if a tract has a medium percentage of Blacks, it is highly likely to remain that way in the next decade (.92).

The GIS shows an interesting pattern for the five tracts that made the transition from medium (B) to high (C) percentage of Blacks (see Figure 5.15). All of these tracts are adjacent to neighborhoods that had high Black percentages in both 1990 and 2000. This would suggest that, although medium-percentage Black tracts have a low probability of making the transition to the high-percentage group, they have a much higher probability of doing so if they are adjacent to high-percentage Black tracts. In addition, the pattern conforms to patterns observed in earlier studies where Black enclaves formed on one side of town. In the case of St. Louis, this was north of downtown. Thus, the Black enclave has traditionally grown outward from an established cluster.

The mapped pattern also suggests evidence of an active tipping point; that is, as the Black area expands northwestward, the proportion of White population decreases, and the neighborhood tips in the direction of majority Black. The 1990-to-2000

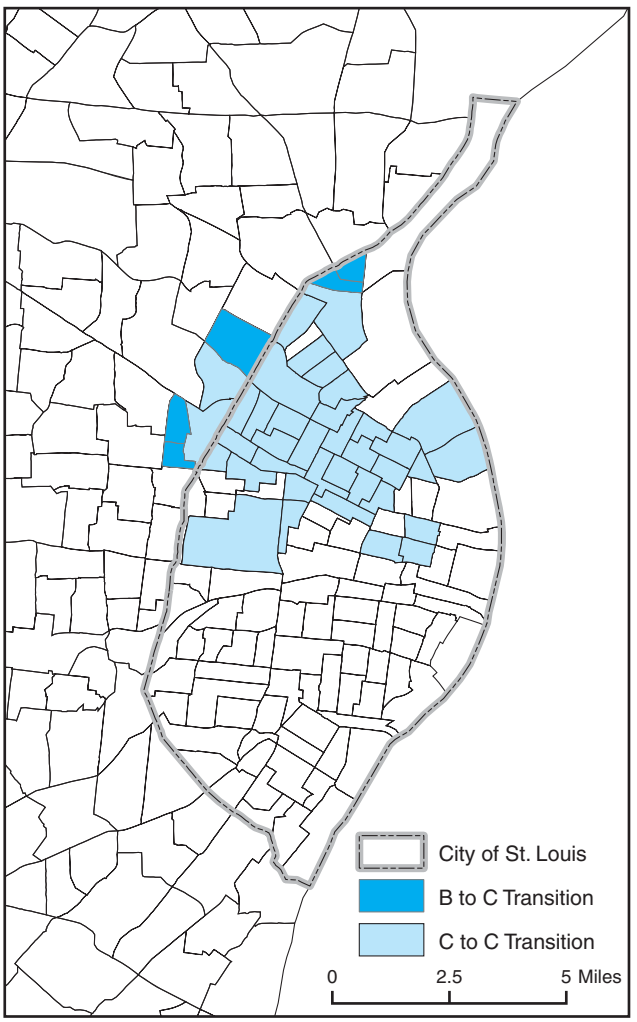


FIGURE 5.15 Racial transitions in census tracts in St. Louis, 1990 to 2000. *Note:* B represents a medium percentage of Black residents; C represents a high percentage of Black residents.

trend also conforms to previous periods when the observed racial integration is short term and the trend is for neighborhoods to be all White or all Black in the long run. Once the wave of transition is complete in one community, adjacent communities will likely experience the same process. Yizhaq, Portnov, and Meron (2004) provided a more elaborate mathematical model of segregation that specifies various contexts and thresholds for tipping points.

There are several limitations to the use of a Markov chain analysis. The first limitation concerns the decision on where to draw the break points for the states. For instance, in a more detailed analysis of the same data, 10 percent breaks were used to create 10 states (see Table 5.1). This was useful for analyzing what occurred in the 10 percent to 89 percent change range, where it was learned that more than half of the census tracts saw an increase in their Black population proportions by 2000.

In addition, the size of the geographic unit used to measure transitions can have an impact on the analysis of integration, whether racial or some other type. As Clark (1965) showed in Los Angeles, the level of integration can be much less at the block level than at the tract level. It is quite likely that there will be variation at the block level; for example, those blocks closest to the established Black core in St. Louis might have a higher Black percentage than would blocks in the same tract, but farther from the core.

5.6 GENTRIFICATION

Gentrification refers to the renovation of deteriorated neighborhoods by upper- and middle-income people. It refers not only to the physical rehabilitation of a part of a city, but also to the social and behavioral transformation from resettlement and displacement (Less & Wyly, 2008; Badcock, 2010). It often involves the gradual displacement of the current low-income residents of the area, who are unable to afford the increased rents as the neighborhood climbs in status. The term originated in London, where it was used to describe a new "gentry," typically composed of affluent, childless, two-worker households that settled into downtown neighborhoods, where they undertook the refurbishing of the older housing stock (Berry, 1999). The process itself became a topic of debate in the early 1980s and mushroomed as a research agenda among social scientists thereafter, partly because it represented a countertrend to the widespread neighborhood decline taking place in cities. Gentrification can be found in cities across the world and has been associated with the processes of globalization (Smith, 1996).

Smith (1979) advanced a controversial theory, the rent gap, to help explain why gentrification occurs in cities. The rent-gap theory is a Marxist interpretation, holding that a gap exists when there is a difference between the capitalized ground rent and the potential ground rent generated by a property (see Figure 5.16). The first concept, *capitalized ground rent,* can be defined as the value of a plot of land given its present use, whereas *potential ground rent* is the profit that could be gained by the same plot of land under a "higher and better use." Neighborhood revitalization or gentrification occurs when investors discover a wide enough gap between the two ground rents (see Figure 5.17 on page 156). Smith (1987) reiterated the simplicity of the theory by suggesting that gentrification is just one means by which the rent gap can be closed. Hammel (1999a), on the other hand, saw the theory as being much broader, with linkages to other urban processes. For example, suburbanization compounds the rent gap of cities, as increased investment on the urban fringe can often imply further disinvestment in the core, which is then ripe for gentrification.

Using 130 years of land-price data for nine redeveloped parcels in Minneapolis, Hammel (1999a) found a rent gap, but his cautious conclusions fell short of finding a one-to-one correspondence between the closing of the gap and the process of gentrification. The study differed from most other rent-gap analyses because it addressed the importance of scale and the geographic unit necessary to examine the rent gap. Promoting Clark's (1988) use of the parcel as a unit of analysis, Hammel (1999a) was able to examine specific locations, whereas most studies examined large districts within cities,

TABLE 5.1 Changes in Black Population in St. Louis by Tract, 1990 to 2000

Year		2000										
		a	b	c	d	e	f	g	h	i	j	Total
Number of Tracts												
1990	a	123	17	5	9	1	1					156
	b	1	6	7	3	1	2					20
	c	1	3	4		3	1	3	1			16
	d			5	5	2	2	2	1			17
	e					1	2	1	2	1		7
	f			1				3	2	3		9
	g							4	1	2		7
	h								1	3	2	6
	i								1	5	3	9
	j	1							1		37	39
Transition Probability Matrix												
1990	a	0.788	0.109	0.032	0.058	0.006	0	0	0	0	0	
	b	0.050	0.300	0.350	0.150	0.050	0.100	0	0	0	0	
	c	0.063	0.188	0.250	0	0.188	0.063	0.188	0.063	0	0	
	d	0	0	0.294	0.294	0.118	0.118	0.118	0.059	0	0	
	e	0	0	0	0	0.143	0.286	0.143	0.286	0.143	0	
	f	0	0	0.111	0	0	0	0.333	0.222	0.333	0	
	g	0	0	0	0	0	0	0.571	0.143	0.286	0	
	h	0	0	0	0	0	0	0	0.167	0.500	0.333	
	i	0	0	0	0	0	0	0	0.111	0.556	0.333	
	j	0.026	0	0	0	0	0	0	0.026	0	0.949	

Note: a = 0 to 9.99, b = 10 to 19.99, c = 20 to 29.99, d = 30 to 39.99, e = 40 to 49.99, f = 50 to 59.99, g = 60 to 69.99, h = 70 to 79.99, i = 80 to 89.99, j = 90 to 100.
Source: 1990 U.S. Census and 2000 U.S. Census.

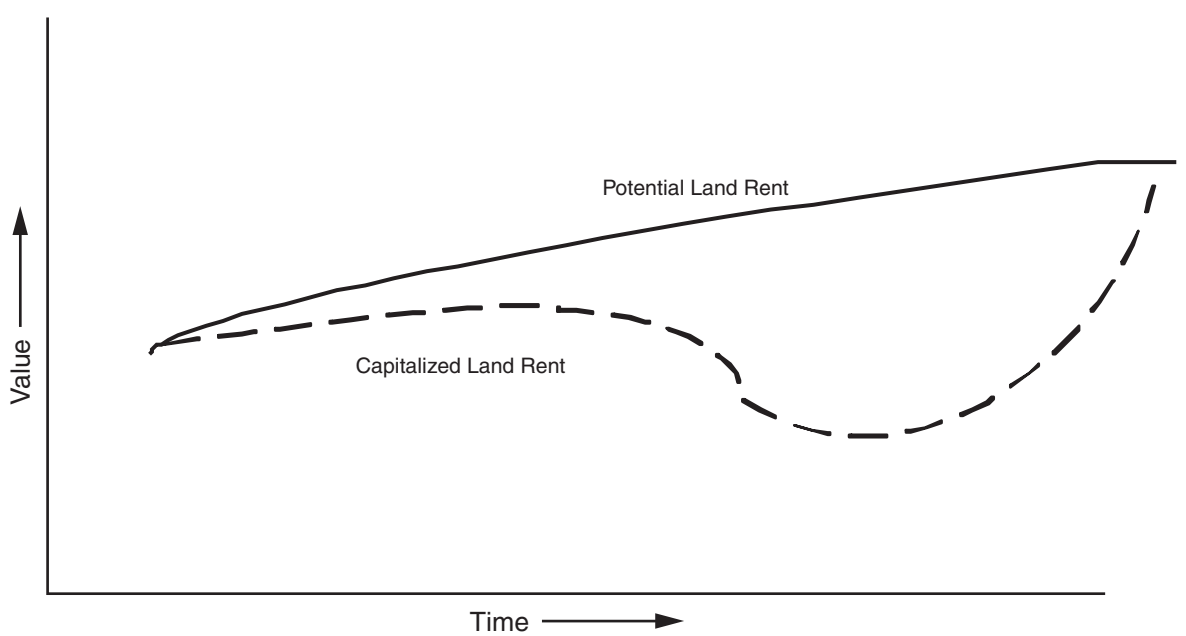


FIGURE 5.16 The rent gap between potential land rent and capitalized land rent. *Source:* Hammel, Daniel J. 1999. "Gentrification and land rent: a historical view of the rent gap in Minneapolis." URBAN GEOGRAPHY 20(2):116–145. © Bellwether Publishing, Ltd. Reprinted by permission. Figure 1. P. 119. "The rent gap is formed by divergence in potential and capitalized land rents as capital investment in the parcel declines."

FIGURE 5.17 Neighborhood gentrification in the Lincoln Park area of Chicago.

which is not regarded as an appropriate area for an analysis of land rent. In spite of some of the shortfalls of attempting to test such an abstract concept with parcel detail, Hammel (1999a) was able to establish rent gaps for each of his parcels. For instance, a parcel near Orchestra Hall experienced its largest rent gap during the post–World War II period of suburban expansion in Minneapolis–St. Paul, and it was subsequently redeveloped (see Figure 5.18). The area extending from Orchestra Hall all the way to Loring Park has been an area where gentrification has become intensified (see Figure 5.19 on page 158). Hammel (1999b) addressed other confusions that had erupted over the issues of geographic scale by suggesting that capitalized rent should be measured at the neighborhood scale, whereas potential rent should be measured at the metropolitan scale. According to Hammel (1999b), a blending of these two scales is critical to an understanding of how the rent gap plays out in cities.

Some urban scholars have wondered why the gentrification process has received so much attention. For instance, Berry (1985) considered some of the early attention to neighborhood renewal trends to be subordinate to larger decentralization trends and coined the often-quoted phrase "islands of renewal in seas of decay." The implication, of course, was that gentrification was small in comparison to the amount of land abandoned by middle-class flight from cities. Bourne (1993) also argued that gentrification's impact was relatively slight, especially as it related to the urban housing stock. In defense of the importance of gentrification as an urban process, Wyly and Hammel (1998) highlighted its impact on the socioeconomic makeup of cities; further, they demonstrated that the financial impact should not be overlooked by showing that gentrified neighborhoods attracted mortgage capital at a rate that grew at 2.3 times the comparable suburban rate between 1992 and 1997 (Wyly & Hammel, 1999).

Recently, authors have been turning to other interpretations of the gentrification process. One study argues that gentrification is indicative of the globalization processes that have been reorienting the city as an "Entertainment Machine":

> Here the stress is on consumption, not production: CNN, MTV, and Hollywood movies are seen as bringing a standard world fare that may encourage more globally homogeneous consumption. It can raise and refocus economic aspirations by redefining consumption desiderata. But much of consumption is driven by local specifics: cafes, art galleries, geographic/architectural layout, and aesthetic image of a city define its unique attractions. (Clark et al., 2002, p. 494)

In this case, more emphasis is placed on consumption as an interpretation of gentrification, with less stress on economic production factors such as finance or jobs. For instance, Ley's (1986, p. 529) conclusion that changes in the economic base of cities have the strongest explanatory power for gentrification is characteristic of the proposed economic interpretations. A consumption interpretation would emphasize that gentrification stems from changing preferences of residents and workers who are choosing where to live less with respect to the location of their jobs and more with respect to where they want to recreate and consume (Clark et al., 2002). In support of this consumption interpretation, Bridge and Dowling (2001) found evidence that the retail spaces of gentrified neighborhoods reflect the consumption tastes of the gentrifiers.

Smith (2002) echoed the concerns that have been raised regarding the definitions of gentrification. Alternative definitions proposed by him would incorporate migration and population processes and would extend the spatial influence of gentrification to include affluent household movement to locations other than those near the downtown—for instance, to aging inner suburbs. He offered a number of research questions that would be opened up if the definition of gentrification were made more inclusive (see Table 5.2 on page 158). Many of these questions focus on the migratory processes and forces influencing gentrification.

A number of studies have presented techniques for delineating or measuring gentrification. Heidkamp and Lucas (2006) were able to identify the predictors of the "gentrification frontier" in Portland, Maine, by using GIS technology and discriminant analysis, a method that shows which characteristics discriminate between two types—in this case, between gentrified and nongentrified census block groups. The gentrification frontier is the geographic dividing line for gentrification in a city. The frontier could be identified through four characteristics: percentage of persons in owner-occupied housing, percentage of those living below the poverty line, change in household income, and percentage of those in technical, managerial, and professional occupations. Gentrification in Portland began when the deteriorated waterfront on the city's southeast was rebuilt into a middle-class consumption space, and the gentrification frontier spread in a fragmented manner in an approximate northwest direction. This detailed and rigorous GIS study of block groups undergoing gentrification highlights it as a fragmented, irregular process that depends on the socioeconomic susceptibility of residents.

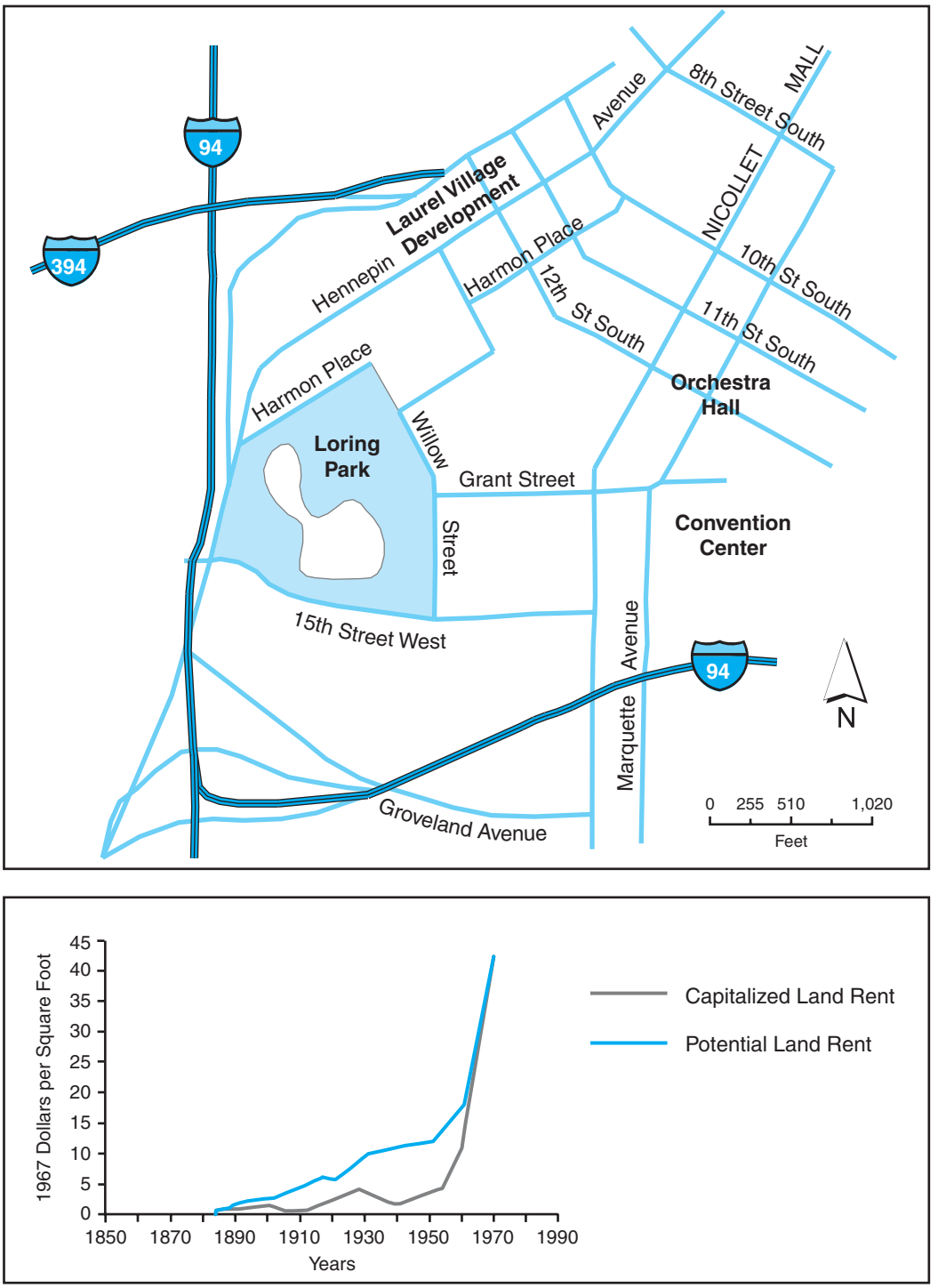


FIGURE 5.18 A century of properties in the Loring Park neighborhood of Minneapolis. *Source:* Hammel, Daniel J. 1999a. "Gentrification and land rent: a historical view of the rent gap in Minneapolis." URBAN GEOGRAPHY 20:116–145. © Bellwether Publishing, Ltd. Reprinted with permission. Figure 3. P. 127.

Jones and Varley (1999) were among the first to look at gentrification in a developing country. Their study on conservation efforts for the historic center of Puebla, Mexico, found corollaries to the gentrification processes identified in cities of the developed world (see Figure 5.20). Brown and Wyly (2001) considered Russian immigrants to Brighton Beach in New York City as gentrifiers, which broke the stereotype of gentrifiers as a young urban professional class. Moore (2009) analyzed the gentrification by middle-class Blacks of a low-income urban area in Philadelphia. This reverses the direction of movement of Blacks to the suburbs in other studies. The study examines the motivating factors for

FIGURE 5.19 Loring Park, Minneapolis.

the returning Black gentrifiers, as well as the interest in the city in encouraging it.

5.7 NEIGHBORHOOD ACTIVISM

Neighborhoods have their own issues and problems to confront. Community and neighborhood organizations are able to tap into the energy and motivation of ordinary citizens to contribute to this problem solving. *Neighborhood activism* refers to active participation by local citizens in their neighborhood and its organizations to address local issues and problems. This section focuses on neighborhood activism as a part of urban geography. It examines the types of problems, steps to solution, and

TABLE 5.2 Gentrification Research Questions

- Where are the places of origin and destination of groups of gentrifier and displaced lower-income households, respectively?
- Do the places of origin and destination and the distances moved, or the frequency of nonmigration from the gentrified place, change over time as the process of gentrification unfolds?
- Do these processes involve different in-migrant, out-migrant, intramigrant, or nonmigrant groups?
- Why do gentrifier and displaced households move into and out of gentrified places?
- Are migratory motives and forces differentiated by social groups who move at different phases of the process of gentrification?
- How do gentrifier and displaced households move into, out of, or within the gentrified place, and do the practices change over time as the process unfolds?
- Where (and why) do gentrifiers and nonmigrants settle within gentrified places?
- Do these internal enclaves and settlement patterns of (non)migrants change over time?

Source: Smith, D. P. (2002). "Extending the temporal and spatial limits of gentrification: A research agenda for population geographers." *International Journal of Population Geography* 8:385–394. Table 3 on gentrification research questions for population geographers (p. 391).

FIGURE 5.20 Gentrification in the Zona Rosa of Mexico City.

key roles that neighborhood and community organizations can play. Several short examples are given of neighborhood activism in St. Paul, Minneapolis, Milwaukee, and Nakuru, Kenya. The section also examines the pluses and minuses of GIS as a tool to help activist organizations be more productive.

Neighborhood activism is more commonly a collective form of expression than an individual form. Groups of neighborhood residents organize to express a group's goals and desires, which are stronger than those of individuals. For example, a neighborhood crime-watch organization expresses the active interests of its members in detecting, preventing, and controlling local crime.

Neighborhood activism in the United States complements or contends with other public-, nonprofit-, and private-sector organizations and institutions. In the public sector, parts of neighborhood issues and problems are handled by metropolitan councils of government, metropolitan planning commissions, city governments and their planning departments, and federal agencies such as the U.S. Department of Housing and Urban Development. In the nonprofit sector, economic and civic development organizations promote business expansion, job growth, and cultural enhancements in cities, often subject to local political systems (Silverman, 2009). The private sector provides neighborhood financing and other services.

At the base, these organizations reflect the pluralism of democracy in the United States—and in many other countries as well. Studies have indicated that neighborhood activism in the United States in the latter half of the 20th century was stimulated by the political trend of neoliberalism (Elwood, 2002; Fraser, 2004; Martin, 2003). In particular, neoliberal government policies have encouraged grants, funding, and support for neighborhood organizations. With so many neighborhood entities, community activism both cooperates and contends with the public sector and other organizations. This creates a tension that is often not easily resolved. Sometimes neighborhood activism must go along with government initiatives and projects, leading to criticism by some of giving in to state priorities or city boosterism (Elwood & Leitner, 2003). At other times, it leads to protests and dissent with government.

One study of neighborhood activism focused on a case study of four organizations in the Frogtown neighborhood of St. Paul, Minnesota (Martin, 2003). The study utilized the theory of collective-action frames, discussed in more detail below, to better understand the organizations and why place was important to them. Frogtown (Thomas-Dale/District 7 officially) is located just northwest of the downtown and has a population that is over 50 percent non-Hispanic minorities, a 35 percent poverty level, and high crime rates.

Two of the four organizations—namely, the Thomas-Dale District 7 Planning Council (District Council) and the Thomas-Dale Block Clubs (T-D Block Clubs)—are discussed here. The District Council, located in a small office, plays a liaison role between neighborhood constituents and the city's agencies for long-range planning, zoning, and land use (Martin, 2003). The T-D Block Clubs have the broad objective of fostering pride in the neighborhood by organizing and motivating residents to make neighborhood improvements—for instance, by holding a "beautiful block" contest to recognize the attractive appearance of yards and homes (Martin, 2003). The block clubs are funded by foundations, donations, and contracts from the city. These two organizations were studied by participant observation and the gathering of documents and materials (Martin, 2003).

The conceptual approach utilized was a *collective-action frame,* which is a group of descriptions of dimensions for collective actions by an organization. In this case, the three frames utilized are motivational, diagnostic, and prognostic (see Table 5.3). The motivational frames indicate how an organization is exhorting actions and describes who and what parts of the community are served (Martin, 2003). The diagnostic frames describe the problems and where they originated (and, at times, blame). The prognostic frames describe the actions to be taken by the organization to solve the problems. The ways the District Council and T-D Block Clubs fit into these three frames are given in Table 5.3. It is clear that the District Council has a focus on neighborhood physical cleanup and planning, whereas the T-D Block Clubs are directed toward improving the neighborhood appearance and fostering its pride and interactivity. As seen in the table's right-hand column, the frames for both organizations emphasize the importance of place—predominantly that of the neighborhood.

Neighborhood organizations benefit by the use of the GIS (Dangermond, 2002; Elwood, 2001; Elwood & Leitner, 2003). A key question, however, is whether their GIS applications should be aligned with government GIS systems or be unique applications driven by neighborhoods' own concerns (Craig & Elwood, 1998; Elwood & Leitner, 2003). Neighborhood and community organizations utilize GIS systems to generate new knowledge about the community and its conditions, to compare GIS output on a neighborhood with government-generated GIS output, to research the processes and relationships underlying the neighborhood, and to monitor and project neighborhood conditions (Elwood & Leitner, 2003).

In a study of GIS use in dozens of neighborhood and community groups in Minneapolis (Elwood & Leitner, 2003), the groups found support from the GIS for strategic, tactical, administrative, and constituent-organizing purposes (Elwood & Leitner, 2003). For example, one neighborhood organization in the Seward area of Minneapolis was able to provide maps and data on housing and financing conditions so buyers and remodelers could achieve better results. In the long term, this improved the whole housing stock and livability of the neighborhood. The study determined that a key to the organization's success is that the government continues to provide free or low-cost access to its spatial data. This allows the organizations the potential to come close to or match the research capabilities of the public and private sectors, or to reach a level playing field (Elwood & Leitner, 2003).

Sometimes neighborhood activism goes through long cycles as the neighborhood changes and may recycle back to earlier identities. In the case of the Riverwest neighborhood in Milwaukee, an activist and "socially inclusive" neighborhood identity was forged in the 1970s (Schmidt, 2009). After 1970s activist practices diminished, Riverwest was quieter for many years, but the activism was reawakened with new practices in the 1990s and 2000s. For instance, the Riverwest Walkers reacted to a violent crime wave in 2006 by forming

TABLE 5.3 Collective-Action Frames for Two Neighborhood Organizations in the Frogtown Neighborhood of St. Paul, 1996–1997

Organization	Motivational Frames[1]	Diagnostic Frames[2]	Prognostic Frames[3]	Importance of Place Frame
Thomas-Dale District 7 Planning Council	Exhortations Plan for future Clean up neighborhood Support/protect children Create community Descriptions: Racial, cultural, economic diversity Historic homes (railroad, working class)	Lack of green, public space Cycle of disinvestment Broader processes/decisions affect local conditions	Plan for future development Industrial Social Economic Infrastructure Long-range comprehensive plans Cleanup days	All three prior frames focus on the neighborhood place
Thomas-Dale Block Clubs	Exhortations Keep neighborhood and houses clean Individuals are responsible for community Win prizes Descriptions: Cultural, religious, racial diversity Children	Garbage in streets, yards Poor attitudes, poor behavior, and lack of responsibility	Foster residential interactions and neighborhood pride Clean up area, plant flowers, and build pocket parks Protest criminal behavior; work with police Old property owners accountable for tenants, cleanup	All three prior frames focus on the neighborhood place Crime may be more widespread in the region

[1]Motivational frames exhort action and describe the community (who, what).

[2]Diagnostic frames describe the problems and assign cause or blame.

[3]Prognostic frames describe the specific actions for solutions.

Source: Martin, Deborah G. 2003. "Enacting neighborhoods." URBAN GEOGRAPHY 24(5):361-385. © Bellwether Publishing, Ltd. Reprinted by permission. Figure "Collective-Action Frames for two neighborhood organizations in Forgtown neighborhood, St. Paul, 1996-97."

groups of walkers who walked through some of the most dangerous parts of the neighborhood in order to put a new claim on space that was lost (Schmidt, 2009). Another act of the walkers was to place numerous signs indicating strength in diversity on the front yards of residents after racist literature was distributed (Schmidt, 2009). Such 30-year cycles have been rarely documented and underscore the fact that a neighborhood may be activist at the core, even if issues are not currently surfacing.

Another potential for GIS use is the public participation geographic information system (PPGIS). PPGIS puts GIS technologies in the hands of a variety of stakeholders for on-line community interchanges. With the Internet, today's PPGIS can include access to and interaction with community data and planning directly by the neighborhood constituents. It has the potential to encourage democracy at the grassroots level (Dangermond, 2002). At the same time, lack of access to the technology by disadvantaged constituents might reduce the potential of PPGIS.

Neighborhood activism occurs in many countries, although the cultural settings, ways it is expressed, and tolerance of it varies. In Nakuru, Kenya, a relatively large and rapidly growing urban center, residents complained of lack of government planning and municipal services (Post & Mwangi, 2009). Government was not able to overcome resource obstacles to provide the necessary services, leading to intense complaints about water shortages, collection of garbage, prevention of crime, "frequent power cuts, lack of medicine, and overcrowding of classrooms" (Post & Mwangi, 2009, p. 670). Local community-based organizations (CBOs) were the principal potential source of activism to remedy these deficits in services. However, the CBOs turned out to be ineffective in fostering activism that led to results. The study ascribed this to the following reasons:

> Community action is frustrated because the latent neighborhood solidarity breaks down on a local power constellation that benefits few and ignores many. Furthermore, surviving amidst scarcity and exclusion encourages people to engage in a multitude of social networks with and beyond the localized community. . . . Investing in community action is simply not a very rewarding option to most residents, especially the poor. (Post & Mwangi, 2009, p. 682)

In this case, activism was stifled by unrestrained local political power, deprivation of constituents, and a sense of hopelessness. This example reveals that activism may be expressed and constrained differently among countries.

In summary, neighborhoods in the United States and many other countries have organizations supported by activists and other constituents that focus their attention on neighborhood and community planning, information dispersal, improvements, services, and grassroots democracy. The GIS can be a useful tool to help these organizations to obtain more information, foster community participation, and achieve better decision making.

5.8 THE IMPACT ON NEIGHBORHOODS OF THE U.S HOUSING, MORTGAGE, AND CREDIT CRISIS OF 2007–2010

The U.S. housing, mortgage, and credit crisis of 2007–2009 stemmed from a "perfect storm" of economic circumstances that caused massive losses of housing value, depressed home sales, defaults on loans, foreclosures, and losses of credit. However, the effects were much broader, since many of the mortgages had been bundled together by banks and other financial institutions and sliced up into small pieces, a process called *securitization*. Subsequently, these pieces were either retained by the financial companies or sold to often unwary buyers in the United States and worldwide. The rise in housing prices was stimulated by low interest rates in the 1990s and led to financial speculation, with real estate assets often viewed as "piggy banks."

The financing of this boom was partly provided by foreign investment flows from China, Europe, and the Middle East (Crump et al., 2008). Mortgage firms provided subprime loans to people in poorer and often minority neighborhoods who did not meet ordinary credit standards. A subprime mortgage is a loan granted to people with poorer credit histories who cannot qualify for a standard loan; as a result, it has higher interest rates and more stringent conditions than an ordinary loan. There is a key question as to whether subprime loans were associated with predatory lending (Kaplan & Sommers, 2009). Predatory lending refers to loans that exceed fair interest rates and take advantage of the poor, minorities, and other vulnerable groups.

Riding the economic boom of the 2000s, mortgage debt increased from $4.4 trillion in 1994 to $9.3 trillion in 2005, in constant 2006 dollars (Ashton, 2009). Subprime mortgage loans grew much faster—from $35 billion in 1994 to over $600 billion by 2005 (Crump et al., 2008). However, starting in 2007, as home prices fell, loan delinquencies and foreclosure rates shot upward. Millions of subprime mortgage holders, in particular, faced financial duress and foreclosure. The worst defaults and foreclosures were located in California, Arizona, Nevada, Florida, and the Midwest (Crump et al., 2008). Subprime foreclosures per 1,000 housing units by state in mid-2009, seen in Figure 5.21, reveal high rates in the Southwest, Florida, and certain midwestern and mid-Atlantic states (Federal Reserve System, 2009).

Although foreclosures occurred first in inner-city neighborhoods, they spread to many other parts of metropolitan areas, especially ones that were poorer. The mortgage crisis impacts have multiplied and led to the downfall of many banks, credit tightening by most financial institutions, employment losses, and reduction in home values (Economy.com, 2009). The devastation for housing has been the worst since the Great Depression. Studies by Economy.com indicate that 5.2 million homeowners in the United States are projected to lose homes from 2008 to 2010 (Phillips & White, 2008), while home prices are forecast to decline by 10 percent or more for two-thirds of the U.S. metropolitan areas and by 50 percent or more in California and Florida (Economy.com, 2009). More broadly, the housing downfall is a principal cause of the cause of the nearly parallel U.S. recession of 2007–2009.

The main motivation for borrowers was the dream of home ownership—and even better, the dream of a home that would forever increase in value. Along the way, money could be taken out of a high-valued home and used for consumption by taking on secondary mortgages. When housing prices peaked in 2006–2007 and began to crash, borrowers often owed more money than their properties were worth (Crump et al., 2008).

A study of 88 homeowners and 39 real estate professionals in five cities throughout the county revealed severe personal and family behavioral impacts from the housing crisis (Fields, Justa, Libman, & Saegert, 2007). Families experienced the dread of foreclosure, family instability, spousal stress, problems in parent–child relationships, and inability to obtain good advice. Respondents felt that the foreclosure threat shook up their stability. At the core, their home, a bedrock of "stability and accomplishment," was being challenged. Professionals interviewed felt that people being foreclosed resembled disaster victims, and many professionals were overwhelmed. People seeking help often had feelings of shame and being looked down upon. The family and personal responses ranged from panicking over what to do to working at extra jobs. However, the added stress led to a fearful and stress-ridden home environment. Some respondents perceived racial discrimination as a reason for pending default and/or foreclosure (Fields et al., 2007).

A recent study has indicated that subprime loans in metropolitan areas were much more prevalent among racial and ethnic minority populations (Darden & Wyly, 2010). For instance, non-Hispanic Black borrowers in the major metropolitan areas of Chicago, Detroit, Houston, Washington, DC, New York, and Boston were at least four times more likely to have subprime loans than were non-Hispanic Whites. Latino borrowers in the metropolitan areas of San Francisco, Los Angeles, San Diego, Phoenix, and Chicago were 2–3.99 times more likely than whites to have subprime loans. The authors point out that these detrimental and long-term impacts on large urban populations that are unequal in terms of race, ethnicity, and location are sobering when compared with the softer landing for many financial companies (Darden & Wyly, 2010).

The nationwide mortgage/foreclosure crisis is impacting neighborhoods. Although it is early to be evaluating the

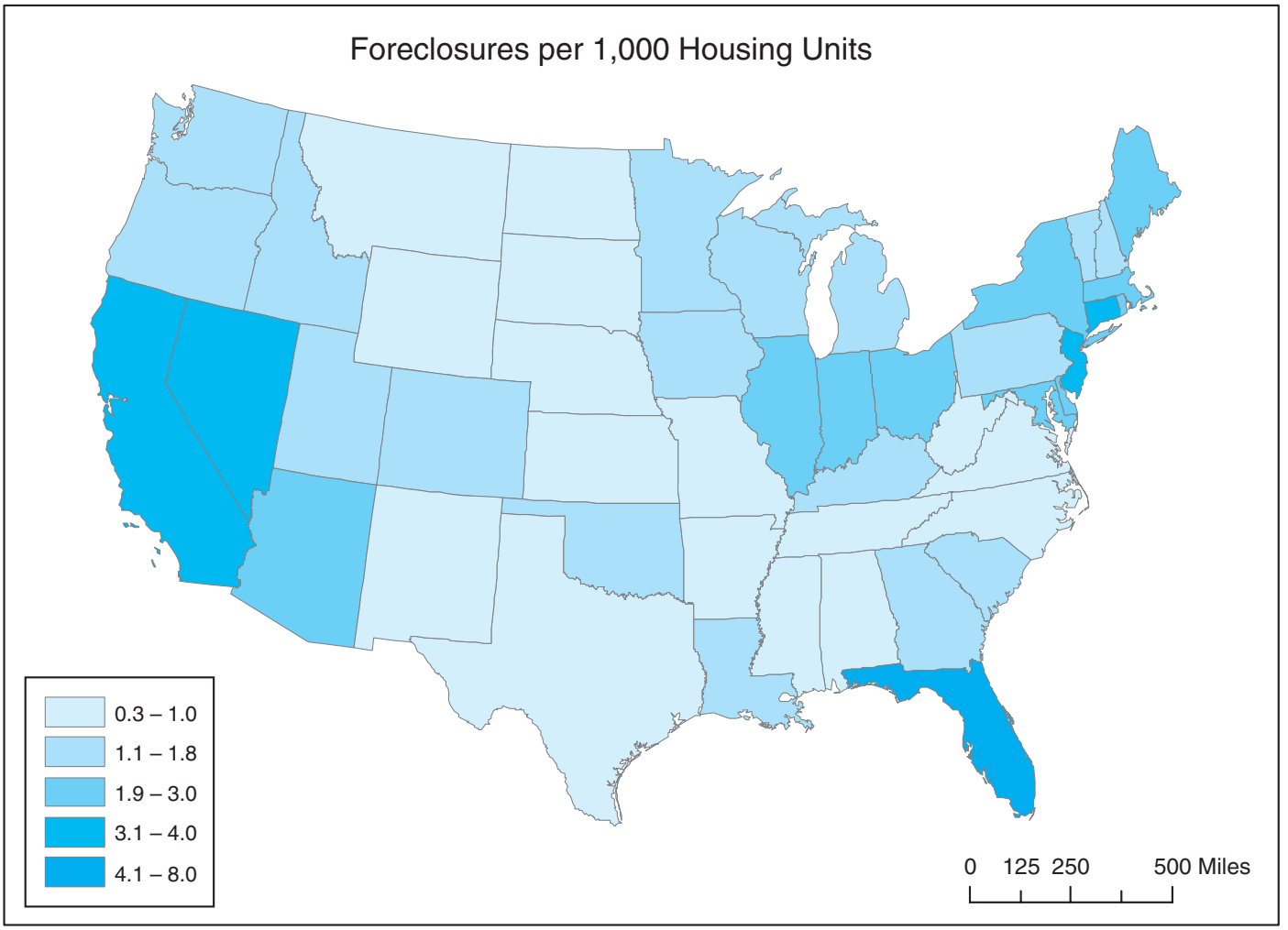


FIGURE 5.21 Subprime loans in foreclosure per 1,000 U.S. housing units, 2009.

long-term consequences, several studies, reports, and forums have pointed to profound impacts (Crump et al., 2008; Kaplan & Sommers, 2009; Steinhauer, 2009a). In a study of foreclosures in 2001–2003 using GIS technology, small areas were identified as impacted in Summit County, Ohio (Kaplan & Sommers, 2009). The foreclosures were concentrated in or near downtown Akron, and they overlapped with elevated loan-to-value ratios, high interest rates, high percentages of subprime loans, and low income. That these circumstances impacted particular neighborhoods was ascribed to low education, low income, and easily available loans. In other words, social and economic inequality was the root cause. It was magnified by predatory lending in these neighborhoods (Kaplan & Sommers, 2009).

An example of a California neighborhood that was in the bull's-eye of the foreclosure crisis is Beth Court, an eight-house cul-de-sac in the city of Moreno Valley, 65 miles east of downtown Los Angeles (Steinhauer, 2009a). From 2007 to 2009, half of the homes on Beth Court went into foreclosure. The lower-middle-class neighborhood, seen in Figure 5.22, was changed by the departure of foreclosed residents and by the arrival of new residents who bought near the bottom of the market and sought upward mobility. "The blockwide birthday parties, neighborly fence-building, and Friday chitchat sessions at dusk have become fragile antiques of the preforeclosure days as the new neighbors keep to themselves and the old-timers struggle to keep their footing" (Steinhauer, 2009a, p. 18). The houses on Beth Court were originally built in 1997 and fulfilled the residents' dreams of home ownership. Early owners were drawn to the clean, affordable, and friendly community. In the economic boom of the early 2000s, many of Beth Court's residents overextended their credit, taking on subprime mortgages and other debt, so when the real estate bust hit, many were forced to sell. In mid-2009, the family in the middle home in Figure 5.22 suffered from unemployment and brought in relatives to meet payments, while in the home on the right, one parent was laid off, creating financial strains. The next home to the right (not shown) is foreclosed; its residents have departed, and the home is owned by a bank (Steinhauer, 2009a).

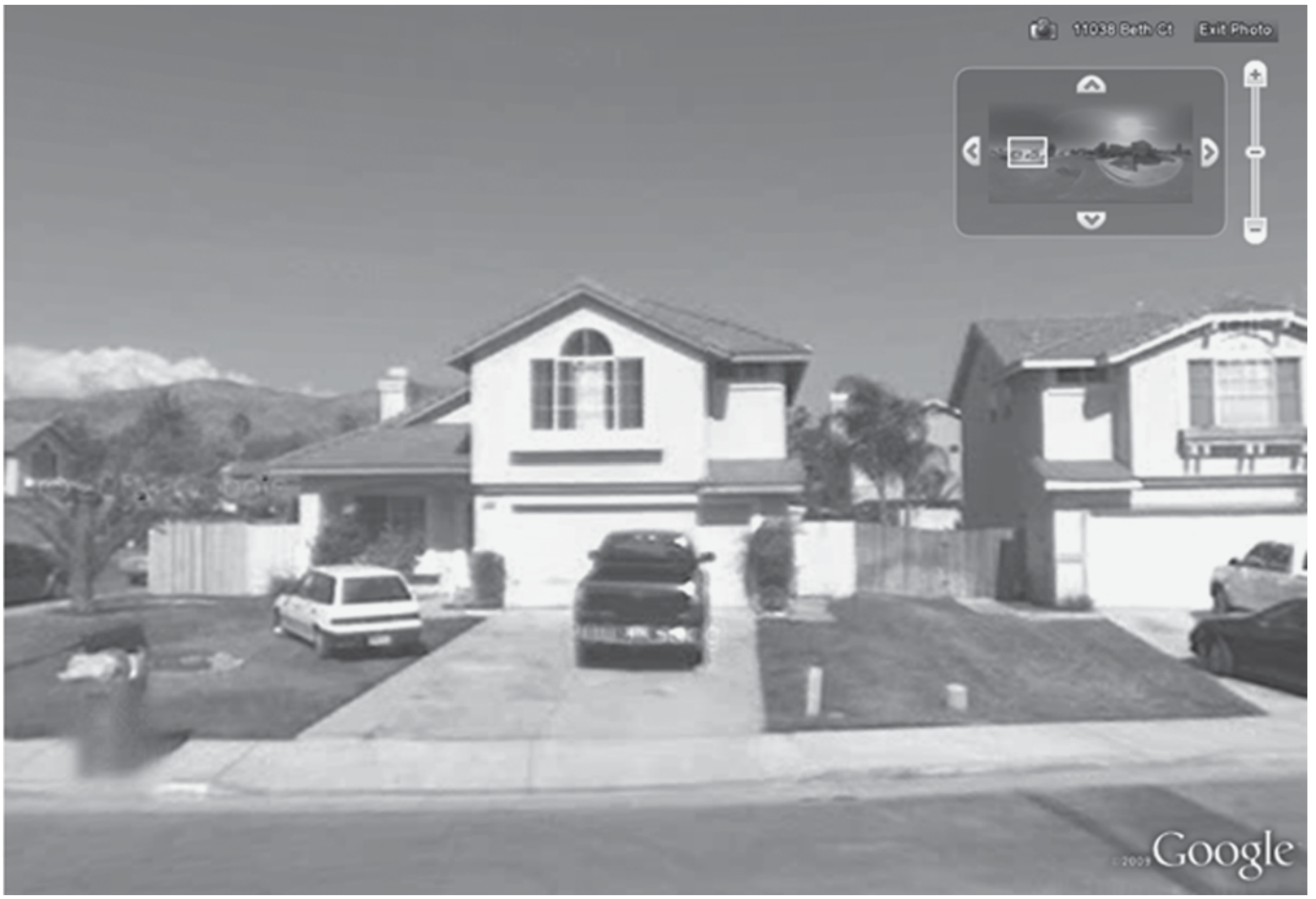


FIGURE 5.22 Homes on Beth Court, Moreno Valley, California, 2009. *Source:* Obtained by J. Pick using Google Earth.

As the neighborhood environment altered, people became nervous. Socializing in the cul-de-sac was reduced, and some new arrivals felt isolated. Some marriages were strained or fell apart. Others had parental role reversal, with the breadwinning spouse laid off and at home and the former homemaker employed. Some children were unattended at times when both spouses had to work. Families cut costs, eating none of their meals out, eliminating children's paid activities, and putting off expenses (Steinhauer, 2009b).

The scenario of human change in this small cul-de-sac demonstrates the inner changes in a neighborhood that can take place in only a couple of years due to a severe housing crisis. It illustrates that a neighborhood at its core consists of the people and families that inhabit it, so urban geographers must not only examine the changes in built structures, economic value, and appearance, but also consider people, families, and behavior.

Summary

The neighborhood has an important function in the city, providing support and identity to its residents. Some have argued that the role of community is threatened by the rapid growth of contemporary suburbia. Nevertheless, evidence is provided in support of the argument that community is alive and well in even the newest of our urban neighborhoods. The interest in measuring the transition of racial composition in city neighborhoods is still strong in urban geography, although more studies today address future outcomes, problems, activism, change, and reasons for continued racial separation and other disparities among neighborhoods. The process of gentrification occurs worldwide and has varying outcomes that involve displacement and replacement of residents. A severe housing and mortgage crisis has stressed U.S. neighborhoods and their inhabitants, demonstrating the inner behavioral aspects of neighborhood change.

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Exercise

Exercise Description
Measuring neighborhood change with Markov chains: The 1990 and 2000 census tract information for the St. Louis area can be used to construct a Markov model illustrating Black neighborhood transitions. The transition patterns can then be mapped and analyzed.

Background Information
Markov Chains: Following is a frequently asked question in urban geography: How does the ethnic and racial composition of neighborhoods change through time? To answer this question using Markov chains, you would first classify neighborhoods based on a characteristic of interest. For instance, to examine the transition question for Black neighborhoods between 1990 and 2000, you would first establish an appropriate percentage threshold for a neighborhood to be considered a Black neighborhood. In this exercise, three states of Black neighborhoods are established: high (90–100 percent), medium (10–89 percent), and low (0–9 percent). Next an examination is made of every two-state combination (e.g., low-to-low Black) for the 1990-to-2000 transition period. As a result, a total of nine two-state combinations are converted into a probability matrix of the following form:

2000 State of Percentage Black

1990 State of Percentage Black	(1) Low	(2) Medium	(3) High	
(1) Low	P_{11}	P_{12}	P_{13}	1.0
(2) Medium	P_{21}	P_{22}	P_{23}	1.0
(3) High	P_{31}	P_{31}	P_{33}	1.0

where P_{11}, the first cell, represents the probability of a neighborhood starting in 1990 with a low percentage of Blacks and ending the period with a similarly low percentage of Blacks. Cell entries in the matrix are calculated by the relative frequency definition of probability:

$$P_{ij} = \frac{f_{ij}}{\sum_{j=1}^{3} f_{ij}}$$

where P_{ij} represents the probability of a neighborhood moving from one Black level to another, f_{ij} is the observed number of transitions from state i to state j, and 3 is the number of states in this exercise.

Google Earth Version

Part 1: Edit the St. Louis Neighborhood Change Table

1. Open the StLouisTrcts spreadsheet in Excel.
   This is a spreadsheet of census tracts for the city of St. Louis with information on the total population and Black population for 1990 and 2000. The columns and their meanings are as follows:
   A – Tract Number
   B – 2000 Population
   C – 2000 Black Population
   D – 1990 Population
   E – 1990 Black Population
2. We will want to add the following five field names in row 1 and columns F through J:

F	G	H	I	J
PctAfAm90	PctAfAm00	Class90	Class00	Chg9000

3. In cell F2, compute the percentage of Black population in 1990.
   = (E2/D2)*100
   Copy the formula down to the end of column F.
4. In cell G2, compute the percentage of Black population in 2000.
   = (C2/B2)*100
   Copy the formula down to the end of column G.
5. Now we will classify tracts as A, B, and C based on their percentage of Black population according to the following ranges:
   A = 0–9.99 Percent
   B = 10–89.99 Percent
   C = 90–100 Percent
6. Sort the spreadsheet on Percent Black (African American) Population in 1990 (column F).

   In cell H2, enter the letter "A," and copy down until the 1990 percentage of Black population remains below 10 percent. Then enter "B" until the 1990 percentage of Black population remains below 90 percent and "C" where it is 90 percent and above.
7. Next sort the spreadsheet on Percent Black (African American) Population in 2000 (column G).

   In cell I2, enter the letter "A," and copy down until the 2000 percentage of Black population remains below 10 percent. Then enter

"B" until the 2000 percentage of Black population remains below 90 percent and "C" where it is 90 percent and above.

8. In cell J2, we want to concatenate H2 and I2:

= Concatenate (H2, I2)

Copy the above formula down to the end of column J.

9. Now sort the spreadsheet by Chg9000 or column J.

10. Below, the first row of the transition matrix is filled in for you; fill in the remaining cells.

	A	B	C
A	20	15	0
B			
C			

Use the relative frequency definition of probability, and calculate the remaining cells below:

	A	B	C
A	.57	.43	0
B			
C			

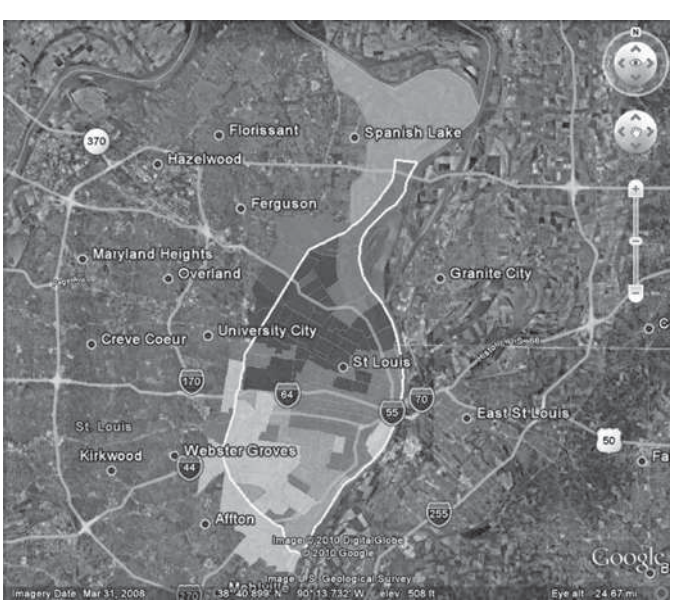
We interpret the above as saying that there is a zero probability of a tract going from a low percentage to a high percentage of Black population in the 10-year period.

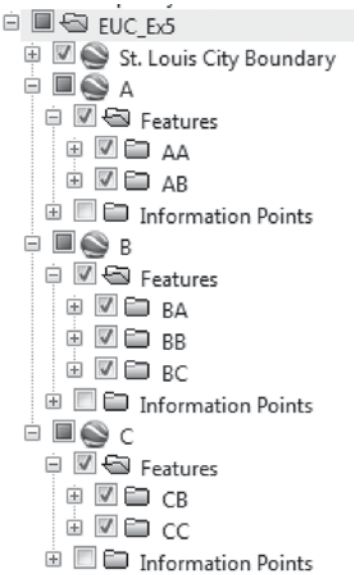
How about the probability of tracts transitioning from a medium percentage to a high percentage?

Part 2: Examine the Locations of Each Transition

11. Launch the Chapter 5 Google Earth KMZ file by double-clicking on it.

EUC_Ex5.kmz





12. The places are divided into A, B, and C.

A (green colors on the map) represents the tracts that transitioned from level A (0–9.99 percent Black) to either the same or different levels.

B (red colors) represents the tracts that transitioned from level B (10–89.99 percent Black) to either the same or different levels.

C (purple colors) represents the tracts that transitioned from level C (90–100 percent Black) to either the same or different levels.

Within green, light green represents AA and dark green represents AB; the same follows for red and purple shadings.

13. To see a particular set of tracts transitioning, turn off all check marks for A, B, and C except the transition you wish to view. For instance, you can turn off all the transitions except BC (medium in 1990 to high in 2000) and CC (high in both 1990 and 2000). Expand features under A, B, or C to see their respective transitions. You should see three dark red tracts being added onto the earlier Black enclave. We chose these three transitions because they demonstrate the growth of an enclave over time. If you turn on Information Points and click on a point, you will see the actual numbers and percentages of Black residents in 1990 and 2000. Save the map that is displayed as a jpg, and turn it in with your essay.

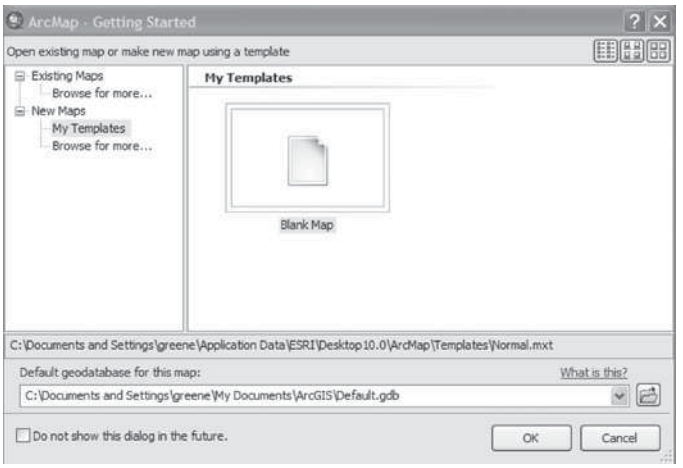
14. Try displaying a variety of transitions until you understand the map and the geography of the transitions.

Google Earth Short Essay: Go through a series of displays on the map to show all the transitions that show a change—for instance, AB. Hence, you will exclude AA, BB, and CC. Make notes on where in the city each change took place. Take a look at the built structures and infrastructure of these change tracts, and comment on any patterns you note.

Then write an essay that describes narrative the *key* geographic changes in Black population that took place at the census tract level in St. Louis in the 1990s.

ArcGIS 10 Version

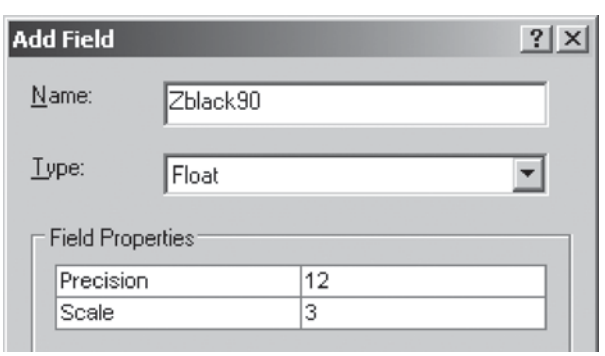
1. Start ArcMap. Under New Maps, click My Templates, and then double-click the Blank Map template.



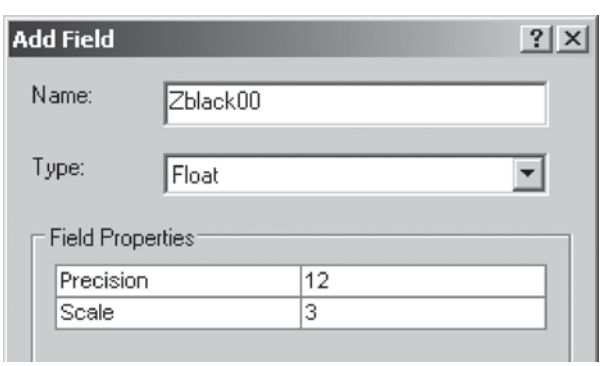
2. Click the Add Data button, and navigate to the exercise data folder.

Note: If you do not see the folder where you placed the exercise data, you will need to make a new connection to the root directory that holds the data.

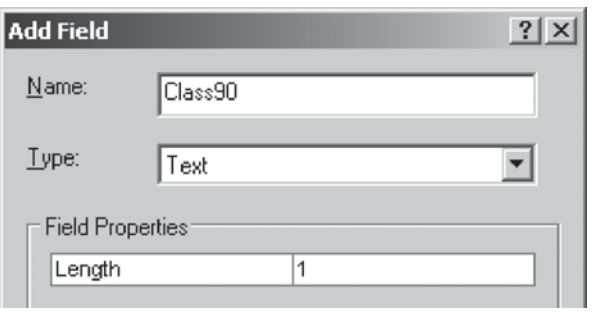
3. Add stl90_00.shp from the Chapter 5 folder.
4. Right-click the name stl90_00, and click Open Attribute Table.
5. Add five columns by clicking the Table Options button and selecting Add Field.
   5.1. Zblack90 as float with a precision (number of digits) of 12 and a scale (number of decimal places) of 3.



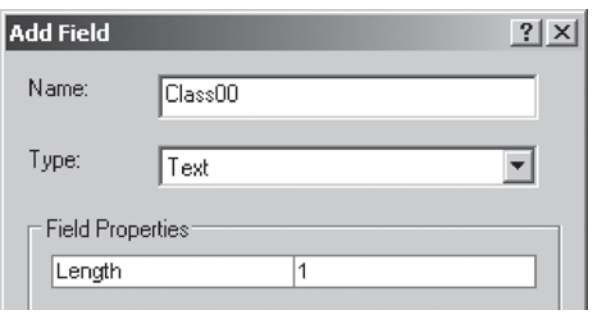
   5.2. Add Zblack00 as float with a precision of 12 with 3 decimals.



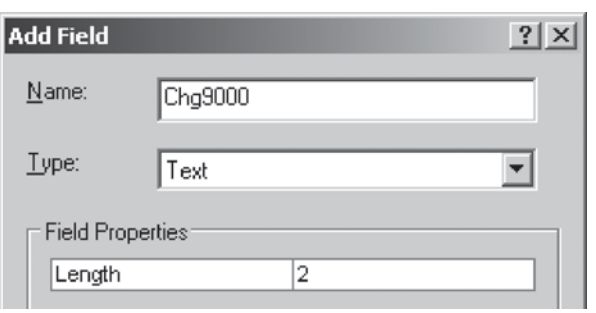
   5.3. Add Class90 as text with a length of 1.



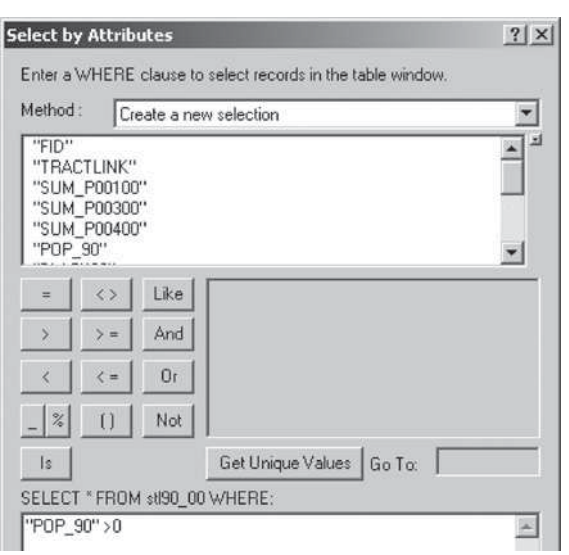
   5.4. Add Class00 as text with a length of 1.



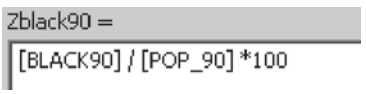
   5.5. Add Chg9000 as text with a length of 2.



6. Calculate the proportion of Blacks in 1990 and 2000:
   6.1. Click the Select by Attributes button, Pop_90 > 0, and Apply. Click OK, and then click Close. (This step is necessary because a tract might have zero population and you cannot divide by zero in the next step.)

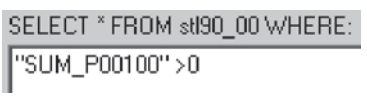


6.2. Scroll over to the right in the table, right-click the Zblack90 field title, and then click Field Calculator. Answer Yes to calculate outside an edit session, and enter the following calculation: [BLACK90]/[POP_90]*100

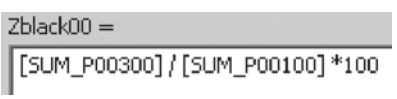


6.3. Click OK.

6.4. Click Table Options, Select By Attributes, SUM_P00100>0, and Apply. Click OK, and then click Close. This step is necessary because a tract's 2000 population (SUM_P00100) might have zero population and you cannot divide by zero in the next step.



6.5. Scroll over to the right in the table, right-click the Zblack00 field title, and click Field Calculator. Answer Yes to calculate outside an edit session, and enter the following calculation: [SUM_P00300]/[SUM_P00100]*100. Click OK. The SUM_P00300 field is the 2000 Black population, and SUM_P00100 is the total 2000 population.



6.6 For Class90 and Class00, we want to assign a letter A, B, or C based on the percentage of Blacks in the census tract.

A = 0−9.99
B = 10−89.99
C = 90−100

1990 A Neighborhood Calculations

6.6.1. Click Table Options, and click Select By Attributes.

6.6.2. Double-click the field ZBlack90, click the operation less than (<), and type "Zblack90"<10.

6.6.3. Click Apply, and then click Close.

6.6.4. Click the Show Selected Records button at the bottom of the attribute table.

6.6.5. Right-click the heading of the Class90 field, and click Field Calculator. Type "A" in the calculation space, and click OK.

1990 B Neighborhood Calculations

6.6.6. Click Table Options, and click Select By Attributes. The next query should read "Zblack90">=10 and "Zblack90"<90.

6.6.7. Click Apply, and then click Close.

6.6.8. Click the Show Selected Records button at the bottom of the attribute table.

6.6.9. Right-click the heading of the Class90 field, and click Field Calculator. Type "B" in the calculation space, and click OK.

1990 C Neighborhood Calculations

6.6.10. Click Table Options, and click Select By Attributes. The next query should read "Zblack90">=90.

6.6.11. Click Apply, and then click Close.

6.6.12. Click the Show Selected Records button at the bottom of the attribute table.

6.6.13. Right-click the heading of the Class90 field, and click Field Calculator. Type "C" in the calculation space, and click OK.

2000 A Neighborhood Calculations

6.6.14. Click Table Options, and click Select By Attributes. The next query should read "Zblack00" <10.

6.6.15. Click Apply, and then click Close.

6.6.16. Click the Show Selected Records button at the bottom of the attribute table.

6.6.17. Right-click the heading of the Class00 field, and click Field Calculator. Type "A" in the calculation space, and click OK.

2000 B Neighborhood Calculations

6.6.18. Click Table Options, and click Select By Attributes. The next query should read "Zblack00">=10 and "Zblack00"<90.

6.6.19. Click Apply, and then click Close.

6.6.20. Click the Show Selected Records button at the bottom of the attribute table.

6.6.21. Right-click the heading of the Class00 field, and click Field Calculator. Type "B" in the calculation space, and click OK.

2000 C Neighborhood Calculations

6.6.22. Click Table Options, and click Select By Attributes. The next query should read "Zblack00">=90.

6.6.23. Click Apply, and then click Close.

6.6.24. Click the Show Selected Records button at the bottom of the attribute table.

6.6.25. Right-click the heading of the Class00 field, and click Field Calculator. Type "C" in the calculation space, and click OK.

7. Click the Show All Records button at the bottom of the attribute table.

8. Click Table Options, and click Clear Selection.

9. Right-click the heading of the Chg9000 field, and click Field Calculator.

Calculate Chg9000=Class90+Class00 (under Type, choose String), and click OK.

10. Determine the probability of a B tract in 1990 making the transition to a C tract in 2000.

10.1. Under Table Options, click Select By Attributes, and enter the following query:
Chg9000 = 'BA' (note that 2 get selected)
Click the Get Unique Values tab to see all values.
Click Apply.
Repeat for the next B transition:
Chg9000 = 'BB' (note that 82 get selected)
Click Apply.
Repeat for the next B transition:
Chg9000 = 'BC' (note that 5 get selected)
Click Apply.

10.2. Close the table.

We can enter the above three entries into our matrix:

Using the relative frequency definition of probability, we calculate:

We find that a tract with a medium percentage of Blacks has a low probability of making a transition to a high percentage (.06). In fact, if a tract is of a medium percentage of Blacks, it is highly likely to remain medium in the next decade (.92). Fill in the remainder of the probability matrix using the selection procedure above for the B transitions.

	(1) Low	(2) Medium	(3) High	
(1) Low				
(2) Medium	2	82	5	89 total
(3) High				

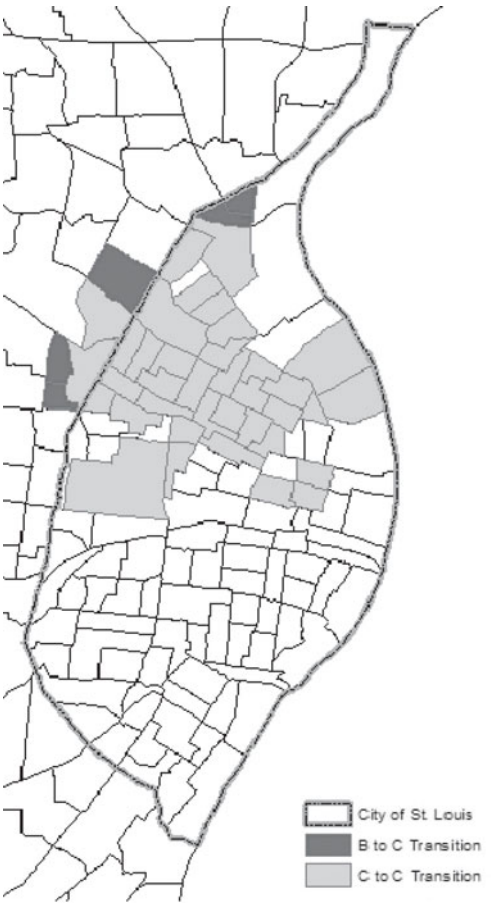
2000 State of Percentage Black

1990 State of Percentage Black		(1) Low	(2) Medium	(3) High	Total
	(1) Low	P_{11}	P_{12}	P_{13}	1.0
	(2) Medium	**.02**	**.92**	**.06**	**1.0**
	(3) High	P_{31}	P_{32}	P_{33}	1.0

11. Mapping the five tracts that made the transition from B to C (BC) reveals an interesting pattern—namely, they are all concentrated around neighborhoods that were highly Black in both 1990 and 2000. This would suggest that, although medium-percentage Black tracts have a low probability of making the transition to high-percentage Black tracts, they have a much higher probability of doing so if they are adjacent to high-percentage Black tracts. Let's make the map to see this visually.

11.1. Right-click Stl90_00.shp, and click as follows:
- 11.1.1. Properties
- 11.1.2. Symbology
- 11.1.3. Categories
- 11.1.4. Unique Values

11.2. Change Value Field to chg9000.
11.3. Click Add Values tab.
11.4. Select 'BC' and 'CC,' and click OK.
11.5. Click Apply, and then click OK.



12. Experiment by mapping other transitions. Map at least two transitions. Note that you can remove a value from the map by again performing Steps 11.1.1 and 11.1.2 and then right-clicking on the value and selecting "remove value(s)." To replicate this map, add the St. Louis city layer to the map, and change its symbol from a solid fill to a hollow fill with a thick outline.

ArcGIS 10 Short Essay: Using the maps and probability matrix that you just created, and the Chapter 5 section "Analyzing an Urban Issue: Racial Segregation," write a short essay describing the spatial pattern of Black neighborhood transitions in the 1990s in the city of St. Louis. Try to explain transition patterns and trends. Discuss the strengths and weaknesses of the methodology employed to measure these transitions.

Log in to www.mygeoscienceplace.com for ArcGIS Exercise data files, Google Earth™ Exercise kmz files, RSS feeds, flashcards, web links, and self-study quizzes to enhance your study of neighborhoods.

CHAPTER

6 Migration and Residential Mobility

Population processes regulate the growth and decline of cities. Within a city, patterns of births, deaths, mobility, and migration contribute to the city's size, shape, immigrant communities, housing supply and demand, and educational needs. In national systems, cities and nonmetropolitan areas are in dynamic flux determined by migration flows. The Sunbelt flow in the United States is a well-known example of migration-driven national flows, with impacts on sending and receiving cities. Between nations, immigration has impacts on sending and receiving countries and augments the ethnic diversity that is emphasized in the next chapter. This chapter focuses on migration and residential mobility, including effects on city processes, such as transport, education, and labor supply. Migration is on the rise in the world as trade barriers fall and larger market systems lead to bigger and more mobile labor pools (Global Commission on International Migration, 2005; International Organization for Migration, 2008; United Nations, 2002). This has also prompted many nations to discourage and restrict migration from other counties. Some countries, such as China, have restricted internal migration.

This chapter first considers the basic concepts and factors of migration—the push and pull factors that lead individuals, families, and groups to pull up stakes and take the risks of moving. It next turns to residential mobility, which consists of shorter-distance moves that often depend on a combination of housing, family life cycle, and jobs. Building on the Chapter 3 discussion of the structure of cities (e.g., that the central business district [CBD] or other zones attract workers), this chapter examines the bias of groups of residential moves toward poles of attraction in cities, a concept termed *directional bias.*

The "Analyzing an Urban Issue" section addresses the problem of how accessible a location is, based on the method of population potential. The practical problem is how accessible four proposed sites in Los Angeles are for siting an environmental education center for non-English-speaking residents. You will base your decision on the site's accessibility for the eligible population living in the city areas surrounding each site.

National migration flows for the United States and Australia are examined and compared. They are driven by economic and geographic forces that differ for each nation and have important impacts on cities.

International immigration is on the rise in the world, which has 191 million lifetime international migrants, mostly living in cities (Martin & Zurcher, 2008). The complex forces of international migration include economics, politics, cultural divisions, conflict, and warfare. In the United States, the largest groups of recent immigrants are Hispanics and Asians, streams that have impacted cities and national life as well. A case looks at the large stream of immigrants from the Dominican Republic to the United States, especially to New York and New Jersey, and their assimilation and adjustments.

Finally, Chinese rural-to-urban migration is studied. China has a distinctive system that controls migration through residence registration requirements, but the country is experiencing greater movement through its change to a socialist market economy. The resultant "floating population" (i.e., rural-to-urban migrants lacking residence documents) is not supported by the government and is often hard-pressed to make ends meet. The chapter should alert you to how migration and residential mobility alter the size and spatial arrangement of city populations and provide you with a basis to understand upcoming chapters on ethnic changes and the urban fringe.

6.1 CONCEPTS AND FACTORS OF MIGRATION

Migration in its fundamental aspect is the process of human movement from one community, state, or nation to another. It constitutes one of the three standard components of population change. The other change components are births and deaths (Kent & Mather, 2002). For cities, annexation can be added. For a geographic unit with fixed boundaries—that is, without annexation—the population change is calculated as births minus deaths plus entering migrants minus departing migrants. Migration differs from births and deaths in not being a biological event, although all are social events. It has complex causes and can be more variable than the other components of population change.

A useful classification of migration divides it into four categories, based on whether it is recurrent versus nonrecurrent and local versus long distance (Jones, 1990, adapted from Duncan, 1959). *Recurrent movement* is movement that repeats on a regular basis, such as commuting, daily crossing of an international border to work, or seasonal movements of farm labor. It is commonly based on the desire to reach a place of work that might be distant from the worker's residence. Thus, local recurrent movement constitutes *commuting,* whereas long-distance recurrent movement is *seasonal work*.

In Table 6.1, *nonrecurrent movement* represents a one-time move—for example, a family moving from Mexico to the United States. This is divided into local moves, referred to as *residential mobility,* and long-distance moves, referred to as *migration* (see Figure 6.1). Local is commonly taken to mean within the metropolitan area boundary, although it can be defined as movement within a county, province, or other unit.

For measurement of local movement, the size of the local geographic unit is critical. For a large unit such as a big county, more movement will be classified as local and less as long distance than with a small county. Thus, the local versus long-distance designations are to some extent arbitrary and depend on the unit size.

The U.S. Census Bureau considers residential mobility as a change of place of residence, within either a 1-year period or a 5-year period (U.S. Census Bureau, 2003, 2004, 2009). It considers migration a change of a person's residence from 5 years earlier that crosses a jurisdictional boundary, so for the census, mobility is a form of migration. The census classifies migration as migration between counties (intercounty), between states (interstate), or between countries (migration to or from abroad).

In this textbook, we refer to movement within metropolitan areas or other urban units such as urban areas and cities as *mobility*. Movement between metropolitan areas or between large units such as states and nations is referred to as *migration*.

For a geographic unit, as seen in Figure 6.1, a stream of migrants arrives (in-migration) and another stream leaves (out-migration). In-migration minus out-migration is called *net migration,* which can be either positive or negative, depending on whether or not in-migration exceeds out-migration. Owing to unavailability of specific migration data, most planning and analysis studies are done in terms of net migration. However, many times in-migration and out-migration are more meaningful. Consider the difference between the stream of migrants from Mexico to the United States and that from the United States to Mexico. Migrants in the two streams are different in average age, occupation, income, nationality, and motives for migration. For certain purposes, such as producing population estimates and projections, it might be more meaningful to focus on net migration. For other purposes, such as assessing the impacts and adjustments of Mexicans in the United States, a focus on the gross number of migrants in a single directional stream is better. *Immigration* refers to in-migration to a particular country from other countries. *Emigration* refers to out-migration from a particular country to other countries.

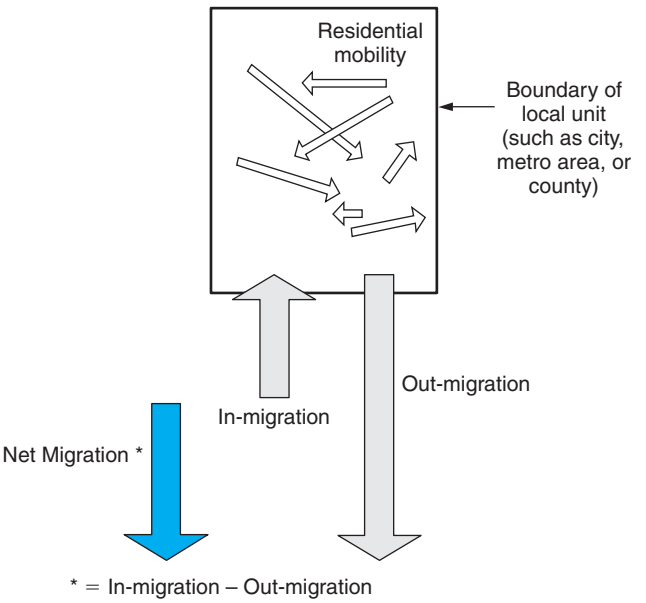


FIGURE 6.1 Migration and residential mobility.

TABLE 6.1 Categories of Movement

	Nonrecurrent	Recurrent
Local	Residential mobility	Commuting
Long distance	Migration	Seasonal work

Source: Hauser, P.M. and O.D. Duncan, (eds.). 1959. THE STUDY OF POPULATION: AN INVENTORY AND APPRAISAL. Chicago: University of Chicago Press. Reprinted by permission of the University of Chicago Press. P. 699. "Human ecology and population studies."

6.1.1 Factors in Migrating

This section examines economic, social, and geographic factors that encourage or discourage residential mobility and migration.

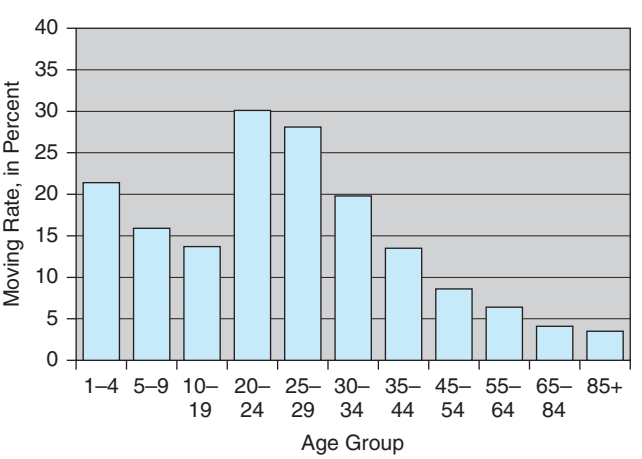
ECONOMIC FACTORS The economic situations at the migrant's origin and destination are crucial to decisions about moving (Martin & Zurcher, 2008). Factors at the origin, often called *push factors,* include economic downturns, unemployment, and low wages, whereas those at the destination are *pull factors,* including prosperity, presence of jobs, guest

FIGURE 6.2 Low-wage workers in Mexico City.

worker recruitment, and especially presence of jobs that fit the immigrant's skills. An example of a combination of push and pull is the hourly income differential between the United States and Mexico, which is approximately eightfold. Such a huge economic differential might make up for migration obstacles and, in fact, has led to huge total immigrant flows over the past 30 years. However, immigration flows from Mexico to the United States declined sharply between 2006 and 2009 due to the severe economic recession in the United States, while the number of Mexicans in the United States that have returned to Mexico has remained steady (Passel, 2006; Passel & Cohn, 2009). Low-wage workers in Mexico are shown in Figure 6.2.

SOCIAL AND DEMOGRAPHIC FACTORS These include age, education, cultural background, language, social networks, and proclivity to chronic moving. Push factors include warfare and discrimination. For age, numerous studies in many countries and regions have shown that younger adults, especially those in their 20s, are most likely to move. Many make moves related to their college and graduate education or to initial job opportunities. Because they often have young families, there are associated high moving rates for young children. For those whose ages range from the 30s into the 80s, there is a steady drop in migration rates due to life-cycle changes. For example, in the United States during 2002–2003 (see Figure 6.3), 30.1 percent of 20- to 24-year-olds moved, whereas only 3.5 percent of people 85 or older did so (Schachter, 2004). The youngest children moved at a 21.4 percent rate, nearly as high as the rate for young parents. Older people, most of them with community and family ties, established careers, or retirement arrangements in their locale, are much more rooted. For 2007–2008, the respective moving rates for age groups 20 to 24, 85 and older, and 1 to 4 were 27, 3, and 17 percent, a slight lowering, and the age-mobility graph appeared nearly the same (U.S. Census Bureau, 2010c). This shows that in the United States age patterns of mobility are steady over time.

With higher levels of education, people tend to have greater job market opportunities and geographic reach, leading to higher moving rates and longer distances. By contrast, uneducated and often unskilled persons have limited geographic market



Moving Rate is the ratio of persons changing residence to the total number of persons, expressed in percent.

FIGURE 6.3 Moving rate by age, United States, 2002–2003. *Source*: U.S. Census Bureau. (2010c). *Statistical Abstract of the United States.* Washington, DC: Author.

opportunities. Similarities in culture and language at origin and destination are positive moving factors, as they help in assimilation and acculturation at the destination. A migrant's social network at destination also is a positive factor. The potential inclusion into a group of new friends and family is a pull; the network potentially offers identity, support, advice, assistance organizations, and even a head start on employment and social mobility. At the same time, it is often hard for the prospective migrant to obtain data on such networks. Immigrant families, such as the one seen in Figure 6.4, usually go through many years of settlement and adjustment at their destination and are helped by networks. Some movers, known as *chronic movers,* might move dozens of times during their lives. A chronic mover has an elevated proclivity to move on the basis of his or her prior experience. This behavioral trait is more common for shorter-distance residential mobility.

GEOGRAPHIC FACTORS Locations of origin and destination, topography, transportation networks, climate, proximity to oceans, distance from employers, and other geographic features can impact moving. For instance, Duluth, Minnesota, and Buffalo, New York, receive less in-migration than some otherwise comparable cities because of their frigid winter climates and remote locations.

Rural-to-urban migration refers to migration from rural to urban areas. Such migration streams can continue for decades and are more prevalent in developing economies, where a large share of the population is still rural. As rural agriculture becomes more mechanized and efficient, traditional agricultural workers have fewer jobs available, and their livelihood suffers. For many, the economic attraction of cities pulls them from impoverished rural settings to seek work in the city. For instance, in the United States during most of the 19th century, there was continuing flow from rural areas to cities; massive immigration of Europeans, mostly from rural zones; and high rates of natural increase. Natural increase is computed as the difference of annual births minus annual deaths, so the natural increase rate is the ratio of that difference to total population. Many large American cities expanded as a result. Within Mexico from the 1920s to today, there has been steady rural-to-urban migration, constituting a major factor in the growth of Mexico City, Guadalajara, the northern border cities, and others. Many of today's Mexican farmers, such as the one appearing in Figure 6.5, face continuing pressures to migrate to urban areas. A study of rural-to-urban migration in West Africa found that once the rural migrants arrive, they adapt quite well to their new urban setting (Beauchemin & Bocquier, 2004). China for the past 20 years has had substantial flows of rural migrants into large cities, even though they work for low wages, frequently leave their families in rural areas, and often lack city residential permits. In China, a residential permit is required in order to live in a city, although controls on residence permitting have been weakened in the 2000s, a topic discussed later in the chapter. Due to these flows, the percentage of urban growth due to migration for many the largest urban areas in China has been 70 percent or more (Liang, Luong, & Chen, 2008).

6.1.2 Forced Migration

Forced migration is migration through coercion at the point of origin. The coercion might stem from a wide variety of factors, such as extreme economic privation, environmental catastrophe,

FIGURE 6.4 Immigrant family from India, in their home. *Source*: © James Marshall/CORBIS.

FIGURE 6.5 Mexican farmer in Chiapas, Mexico. *Source*: Getty Images Inc.–Image Bank.

ethnic and racial conflict, persecution by despotic rulers, war, or decisions by immigration authorities to force certain residents to be deported or repatriated (see Figure 6.6). To be forced, the extreme economic privation goes beyond severe poverty to also involve risk to health and existence. Normal factors of age, education, employment, and marital status, among others, might condition a migrant's decision to submit to coercion factors. The scale of the forced migration might vary. For instance, the causes can apply to an individual or to a whole segment of a population, such as a tribe or ethnic group. Fundamental to forced migration is the belief by individuals that flight is mandatory (Wood, 1994). Forced migrants might enter another nation as legal or illegal immigrants or under a special category, such as refugee or asylum seeker (Wood, 1994).

The number of refugees and asylum seekers worldwide in 2008 was estimated at 13.6 million (U.S. Committee on Refugees, 2009). Since many refugees and asylum seekers eventually reach a durable solution to their status, including citizenship, they are no longer classified as refugees/asylum seekers. Origin nations sending out the most refugees are the poorest ones, usually subject to intense military conflict, and mostly located in the Middle East, Africa, or Southeast Asia (U.S. Committee for Refugees, 2009; Wood, 1994). In 2008, the country that received the largest number of refugees and asylum seekers was Syria, with 1.8 million. Of these, 1.2 million were from war-torn Iraq. Iran had 994,000 refugees/asylum seekers, of which 936,000 were from Afghanistan. The United States had 161,000, with the largest portions coming from Cuba, China, Myanmar, and Iraq (each in the range of 15,000 to 25,000).

Forced migrations can involve mass exodus from or mass arrivals to cities. An example is the 1970s forced mass immigration of more than 100,000 refugees from Vietnam to the United States, with a large share eventually ending up in Orange County, California. After the Vietnam War ended in 1975, many Vietnamese immigrants came to the United States through Camp Pendleton, just south of Orange County, and later most were sent to sponsors in many parts of the country (Allen & Turner, 2002). However, eventually a large number of naturalized families return-migrated to Orange County, forming the large Vietnamese community centered in Westminster and Garden Grove known as Little Saigon, pictured in Figure 6.7 on page 177. The location of Vietnamese population in southern California is shown in Figure 6.8 on page 177. Today, the migrants and their descendants form the largest single Vietnamese immigrant community in the United States at 135,000 and have a significant impact on Orange County's social services, employment, economy, and culture (Allen & Turner, 2002). This community represents one-eighth of the nation's 1.12 million Vietnamese residents.

Many of today's proven migration factors were recognized more than a century ago by British statistician E. G. Ravenstein. He identified the migration principles of rural-to-urban migration, economic push and pull, out-migration versus in-migration, return migration, patterns of short-distance moves, and many others. Consider these excerpts from three of the "laws" of Ravenstein (1885), along with comments on their relevance today.

1. "Each main current of migration produces a compensating countercurrent" (Ravenstein, 1885, p. 199).

   This refers to the well-known tendency for return migration, or the proclivity of a migrant from a certain point of origin to return to that origin.
2. "Migrants proceeding long distances generally go by preference to one of the great centers of commerce and industry" (Ravenstein, 1885, p. 199).

   This refers to the tendency for immigrants to enter large urban areas. For instance, in the past two decades U.S. immigrants have tended to enter Los Angeles, Houston, Chicago, Washington, DC, and other large urban areas.
3. "The great body of our migrations only proceed a short distance" (Ravenstein, 1885, p. 198).

   The preponderance of movement is residential mobility, involving short-distance moves often of less than 10 miles. For instance, 8.4 percent of Americans changed residence in the same county during 2008–2009, but only 0.4 percent immigrated from abroad (U.S. Census Bureau, 2010d, Table A-1).

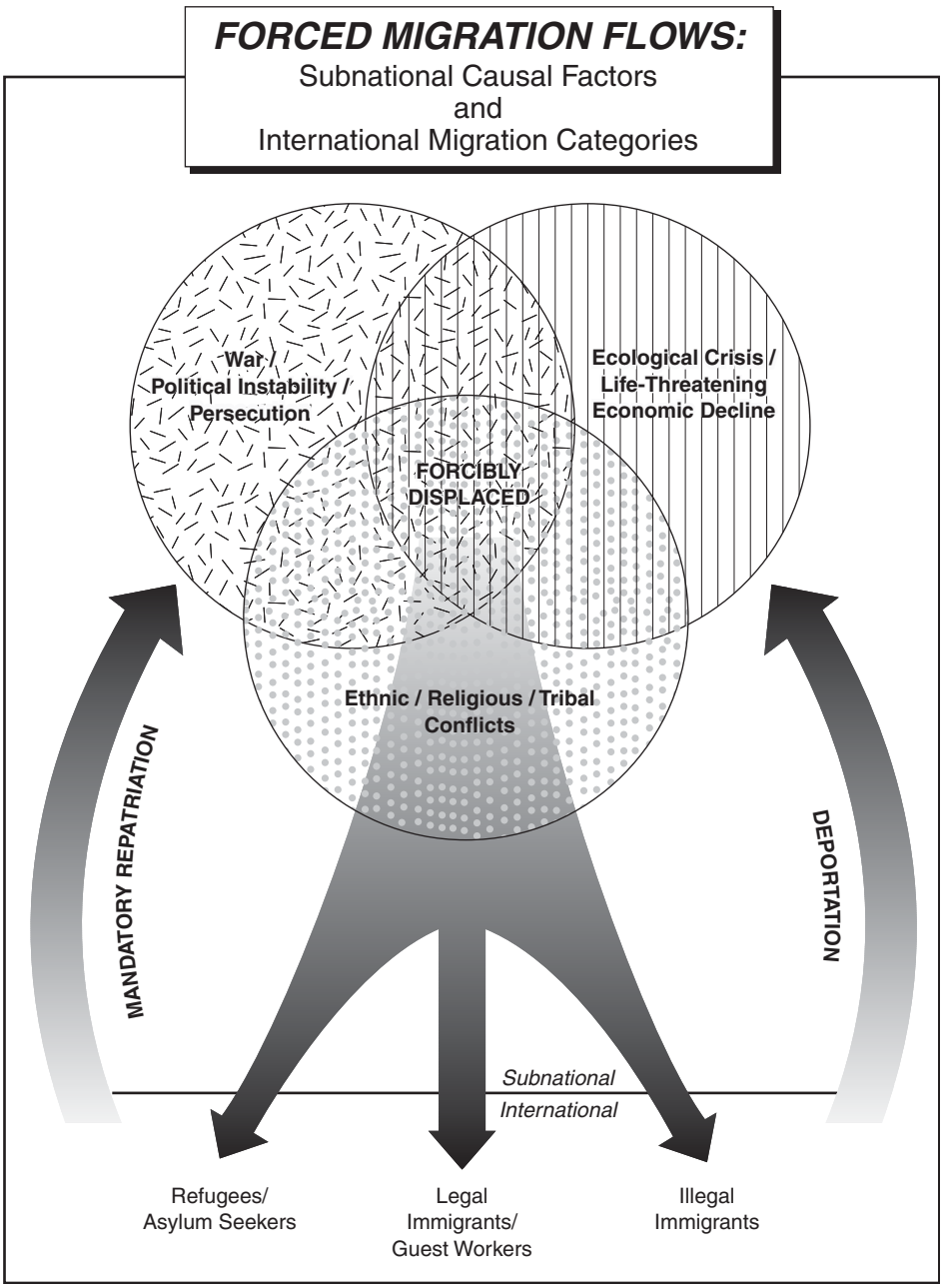


FIGURE 6.6 Model of forced migration.

What differs today from Ravenstein's time is the collection by governments and international agencies of large amounts of migration data from such varied sources as population registries, censuses, special surveys, and administrative sources, including the drivers' licensing and health care systems. The Current Population Survey (CPS), a national survey conducted monthly by the U.S. Census Bureau for the Bureau of Labor Statistics, regularly includes migration supplements, which have been valuable in documenting multiyear trends in U.S. migration, including frequency, social determinants, and regional flows. Likewise in 2002, the United Nations Population Division surveyed international migration for 239 countries or areas, yielding an unprecedented range of worldwide data (United Nations, 2002). Hundreds of other nations' surveys, censuses, and reports on migration are available.

6.2 MEASUREMENT AND MODELING OF MIGRATION

This section concentrates on the measurement of net migration and the gravity model. Both of these are useful for estimating migrants coming into or out of urban areas. *Net migration* is calculated by the equation

$$M_n = (P_{t+n} - P_t) - (B_n - D_n)$$

FIGURE 6.7 Mall food court in Little Saigon, California. *Source*: PhotoEdit.

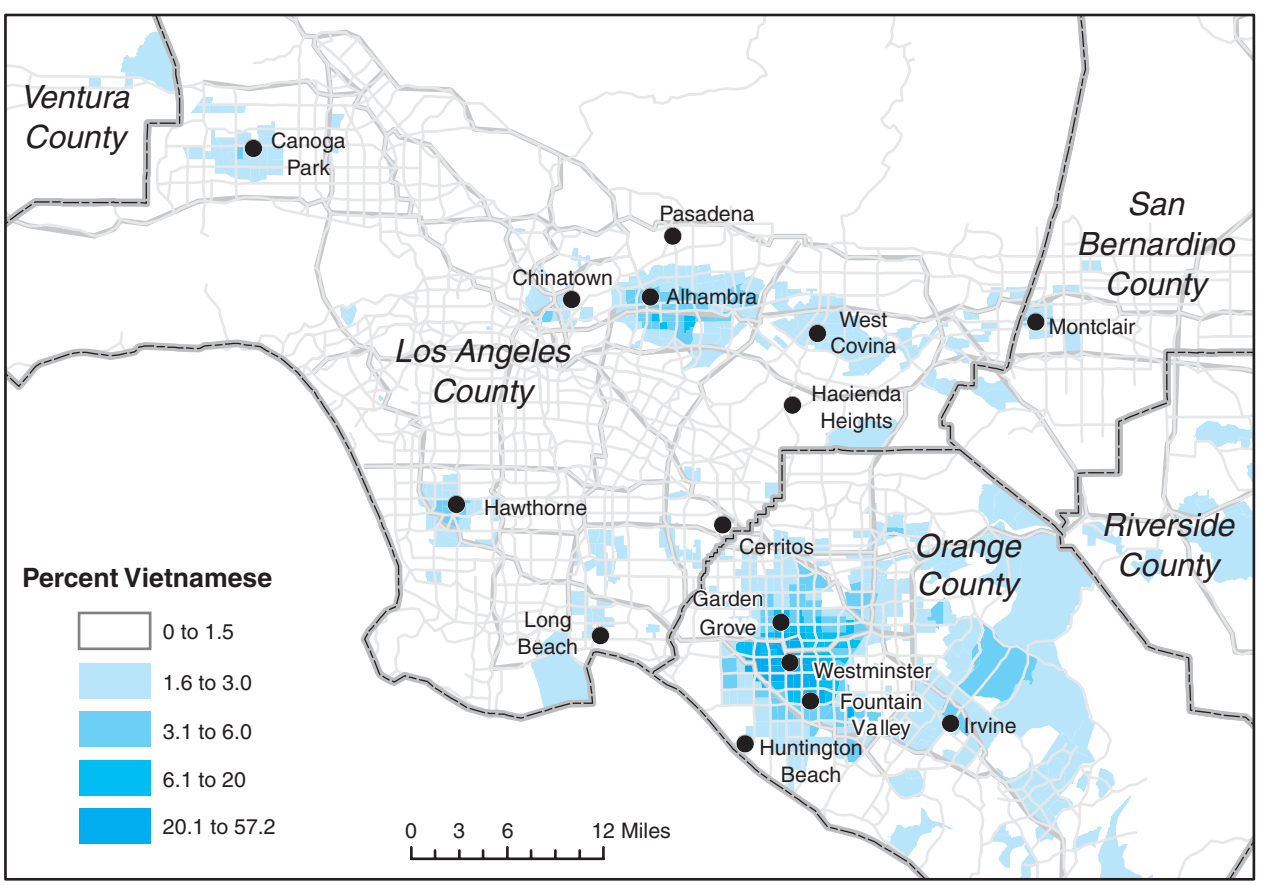


FIGURE 6.8 Location of Vietnamese population in southern California, 2000.

where M_n represents the migrants between time t and $t + n$, P is the population at a particular time, and B and D are births and deaths during period n.

The *vital statistics method* utilizes this equation to calculate net migration. The method is fairly easy to apply in the United States for counties or larger regions, as county population totals are available from the Census Bureau and county births and deaths are collected by the National Center for Health Statistics in cooperation with the states. If sufficient data by age group are available, they can also be applied for a single age group, which will yield the number of migrants for that age group.

An example would be to calculate the number of net migrants into Big City from 2005 to 2010. The population of Big City in 2005 was 1,250,000, and in 2010, it was 1,550,000. There were yearly averages of 25,000 births and 18,000 deaths during the 5 years. Net migration is calculated as follows:

$$M_{2000-2005} = (1{,}550{,}000 - 1{,}250{,}000) - 5^{*}(25{,}000 - 18{,}000)$$
$$= 265{,}000$$

Another fundamental method for modeling migration is the *gravity model* (Jones, 1990; Zipf, 1949). The equation for this model is

$$M_{ij} = k(P_i \times P_j)/D_{ij}$$

where M_{ij} represents the number of migrants flowing between point i and j, P is the population at point i or j, D_{ij} is the distance between points i and j, and k is a constant. P_i is the population at origin, which represents a pool of possible movers. In other words, it represents the people at origin subject to "push" factors. The P_j at destination represents its population attraction ("pull"). The distance between points i and j serves as a proxy for the magnitude of intervening factors that reduce the likelihood that migration will take place. The longer the distance, the harder to break the personal bonds at origin, establish new ones and a social network at destination, and obtain complete information about the destination and its opportunities, among other things. Sometimes in the model, the population (P) variables are replaced by economic (E) variables.

The gravity model is useful in gauging migration flows into or out of urban areas. It helps in conceptualizing that a longer distance for the move reduces migration and that both origin and destination population or economic features influence moves. For instance, international migration from Chile to the United States is at a very low level, as reflected in the resident population of only 68,849 persons of Chilean origin in the United States in 2000, one of the smallest populations from Latin America (U.S. Census Bureau, 2001). The gravity model predicts a small amount of migration because the population of Chile, 16.8 million in 2008, is relatively small (P_j in the numerator) and the distance between the United States and Chile (roughly 5,200 miles) in the denominator is large.

The gravity model was developed further by Stouffer (1940) and other later modelers, who substituted the number of intervening opportunities for distance. Intervening opportunities—such as competing employment centers, government restrictions, start-up costs at the destination, and transportation costs—interfere with successfully moving between the origin and the destination. In the example of migration from Chile to the United States, the intervening opportunities include Chilean restrictions on out-migration, U.S. restrictions on immigration, moving costs, capital costs of housing in the United States, and better opportunities for employment in Chile or closer to it. Other kinds of models to measure migration change, such as regression, forecasting, and use of administrative databases, are beyond the scope of this book, but they are useful to students who go further in urban geography (Siegel & Swanson, 2004). The two basic models—vital statistics and gravity—are data friendly and fairly easy to apply.

6.3 BEHAVIORAL PROCESSES FOR RESIDENTIAL MOBILITY

Residential mobility is movement to a new residence within a city, metropolitan area, county, or province. It is different from migration in that the mover does not move across the boundary of the geographic unit of origin. These moves tend to be short and more frequent than for migration. Residential mobility has significant social and behavioral impacts on people, although, unlike migration, it often leaves intact the social network and familial ties and frequently leaves intact a job. Residential mobility is driven by *adjustment causes*—that is, response to temporary economic and market fluctuations—and *induced causes*—that is, responses to permanent or semipermanent aspects of jobs, the economy, or the life cycle of workers (Clark, 1986). *Adjustment factors* consist of Housing (cost, change in tenure, space, and quality/design), Accessibility (family and friends, shopping/school, and work place), and Neighborhood (socio-economic mixture, perceived quality, physical environment, and government services. *Induced factors* consist of Employment (job hiring, job change, promotion, retirement) and Life Cycle (change in status of marriage or living together, household size and composition changes, and household formation and dissolution) (modified from Clark, 1986).

Adjustment factors are responses to temporary changes in housing, neighborhoods, and accessibility. Consider your own residence and whether you are satisfied with your present housing unit, neighborhood, and transportation access to your usual destinations. If you are dissatisfied with them, you are more likely to move. For housing adjustment, the subfactors include housing space, design, financing, and maintenance. For instance, a family with new children might outgrow its home, necessitating a move. Housing, seen in Figure 6.9 for a suburban neighborhood, can be a factor in family mobility. The housing market in your neighborhood might change versus those in other neighborhoods, implying it is a good time financially to move to another part of the city. As discussed in Chapter 5, neighborhood attractiveness or unattractiveness to its residents depends on the neighborhood's position in its cycle, physical appeal, public services such as schools and parks, commercial and cultural aspects, income, crime levels, and social and ethnic characteristics. Accessibility factors

FIGURE 6.9 Housing in suburban neighborhood: Migration factor.

include physical access to work, friends, family, schools, shopping, and leisure activities.

Government policy influences the adjustment factors. For instance, the federal government impacts mortgage markets through the mortgage institutions it sponsors such as the Federal Housing Authority, Fannie Mae, and Freddie Mac and through veterans' mortgage benefits. As seen in the mortgage crisis that helped to trigger the Great Recession of 2007–2009, those markets played a role in determining housing cost. During the recession, the federal government took special measures to shore up institutions such as Fannie Mae and Freddie Mac and to provide assistance to some mortgage holders faced with foreclosure. Another example is the interstate highway program that was initiated in the 1950s by the Eisenhower administration. The presence of these major highways in metropolitan areas has affected residential commuting patterns and the factor of accessibility. State and local government policies also affect the factors.

Induced reasons for residential mobility are, broadly speaking, long-term, unavoidable ones. They include jobs and the family life cycle. Changes in jobs and employment that are involuntary stem from business and job market factors that are often beyond the control of the individual, such as downsizing, layoffs, transfers of people and facilities, and mergers. Any of these might necessitate residential mobility to be closer to a transferred job, to seek or change jobs, or to afford housing.

The family life-cycle approach refers to the impact of an individual's life course on residential change. A general model of this is seen in Figure 6.10. For example, let us consider an individual who is making residential moves throughout her life cycle. Growing up in the original parental household, this individual moved several times with her family. At college, she changed residence to live in a college dormitory. After college, she started a sequence of jobs and changed apartments several times to be near her work. After getting married, she and her husband moved to a small home. With the birth of her second child, the family outgrew their first home, and upgraded by selling it and buying a larger one. Later on, the family did well economically, enabling them again to upgrade to a larger home in a nicer neighborhood. A family moving from a middle-level neighborhood to more upscale one is seen in Figure 6.11. Unfortunately, the parents later divorced, and the husband moved to a condominium across the city. The wife remarried, and her new husband moved into her home. Late in life, that couple, now empty nesters, decided they had too much space, downsizing to an apartment. Finally they moved into an assisted-living facility. In all, this family life cycle consisted of a dozen

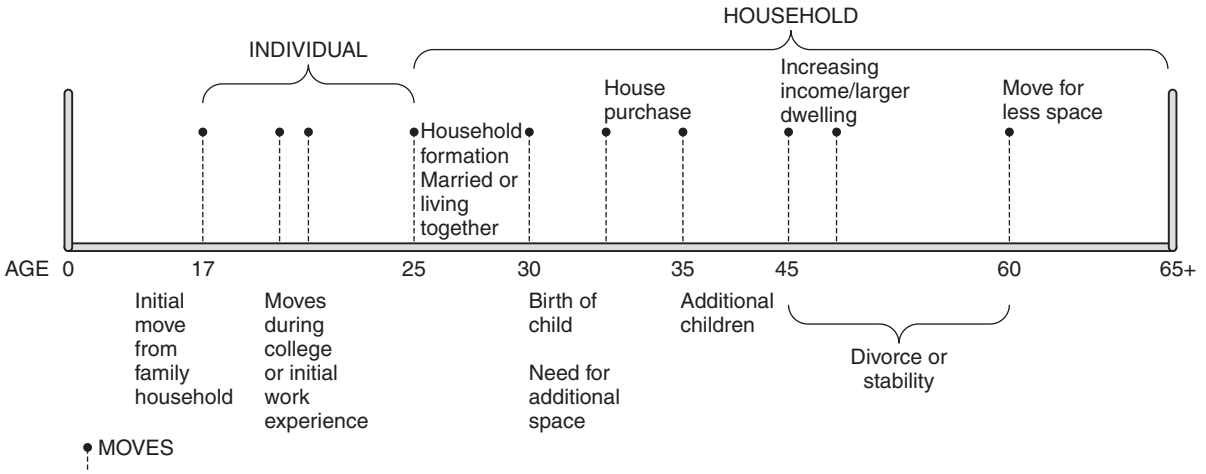


FIGURE 6.10 General model of family life cycle for residential mobility. *Source*: Clark, William A.V. 1986. HUMAN MIGRATION. Copyright 1986 by Sage Publications Inc. Books. Reproduced with permission of Sage Publications in the format Textbook, Other book and Presentation via Copyright Clearance Center. Figure 2.6. P. 39. "A Life Cycle Perspective on Mobility."

residential moves, which were strongly induced at particular time points.

The most important reasons for moving are housing adjustment, neighborhood adjustment, family, and life-cycle change. In a study of U.S. residential mobility (i.e., within a county) for 2004–2005 (Bogue, Liegel, & Kozloski, 2009), the most important reasons for moving were new/better house (24% of respondents), wanted to own home (12%), housing—other reason (12%), family-related—other reason (10%), establish own household (9.5%), and marital status change (7%). Housing and family-related reasons accounted for 88 percent, while work-related reasons combined were only 7%. This supports the importance of housing adjustment and family life cycle for residential mobility.

FIGURE 6.11 Family in process of moving to a more upscale neighborhood.

All this leads to substantial residential mobility in the United States. The number of individuals 1 year old and older moving in the United States in the mid-first decade of the 21st century remained steady at 39 million to 41 million yearly (Bogue, Liegel, & Kozloski, 2009; Schachter, 2004), and the percentage that moved, including migrants, was consistently between 13 and 15 percent (Bogue, Liegel, & Kozloski, 2009; Schachter, 2004). Compared with other countries, this ratio of one in six persons moving each year is quite high. It compares to Australia's 18 percent residential mobility rate in 2000–2001 (Hugo, 2003), but is double the rates of Britain and Japan. For any of these nations, the residential causes can be ascribed to the reasons given earlier. Britain's small land area might constrain mobility.

In very dense, built-up cities, housing units are often expensive, so residential mobility is associated with the limitations on households living under tight spaces. Hong Kong is a metropolis in which most families live in very small apartments, which is surprising since it is a wealthy city. A study of residential mobility and consumption of space in Hong Kong indicated that most residential moves were from rental unit to rental unit and there was about the same percentage of upgraders of space as downgraders of space (Yip, La Grange, & Forrest, 2009). If the residential move was from renting to owning, the living space was more likely to be upgraded in terms of space, but if it was from owning to renting, it was more likely to be downgraded. For a single move, the living arrangements of the family are most important. However, when all the housing units are considered together, the space consumption is influenced most by social, economic, education, and locational factors, rather than living configurations (Yip et al., 2009). This investigation is important in emphasizing the importance of household living arrangements when a city is very dense with tight real estate offerings.

The reasons the particular nations vary in residential mobility are complex and depend on many geographic, cultural,

and demographic factors. For instance, Japan has one of the world's oldest population age structures, with 22 percent of the Japanese population over age 65 versus 13 percent for the United States, 13 percent for Australia, and 19 percent for Germany (Population Reference Bureau, 2009). As mentioned earlier in the chapter, old age tends to reduce migration rates. Japan's rooted family traditions are another factor. For Mexico, culture is also important. Mexico's residential mobility rate of 5 percent every 5 years (measured between 1995 and 2000 and summarized by López Villar, 2003) is much lower than that for the advanced nations mentioned, even though its age structure is much younger, with only 6 percent over age 65. More than offsetting this, however, are Mexico's strong cultural traditions of family and residential stability. A contrasting picture is the residential mobility in informal slum settlements in Bhopal, India (Lall, Suri, & Deichmann, 2006). Slum dwellers are not satisfied with their dwellings, but the government and private donors provide almost no support for slum upgrading. Only one-fifth of households are successful in moving out of slum settlements. Since little institutional financing is available, the critical factor in moving is the savings rate of the household. Surprisingly, most slum residents are satisfied with access to jobs and transportation, and many would prefer to move nearby (Lall et al. 2006).

6.4 DIRECTIONAL BIAS IN MOVING

Residential mobility consists of many short-distance moves. Figure 6.12 (top) shows a hypothetical set of directional residential moves for a section of Portland, Oregon. If all the moves are lined up and altered to have the same direction it is clear that most of the moves are for shorter distances, with only a few for long distances. The curve for the distribution of residential moves resembles an exponential distribution, so there are many more short-distance residential moves (Clark, 1986). The short distance stems from people and families trying to maintain existing neighborhood and social network ties as much as possible.

Another way to rearrange this map of moves is to line all the moves up at the same point of origin, while retaining their original directions (Figure 6.12, bottom). Now it is evident that the moves as a group have an overall average direction, which is shown by the thicker arrow. In this illustration, the overall direction points toward the central city, which is the urban area's largest accessible employment center.

Directional bias is the overall average direction of a group of residential moves. It was originally studied in the late 1960s, starting with seminal papers including that of Adams (1969). Studies have shown that directional bias in cities tends to be toward the CBD or toward suburbs that have employment opportunities.

Today, directional bias also needs to take into account a wider range of models, including the large developing-world cities. For instance, Mexico City grew in the past three decades through urban rings that have expanded outward, while the city center has depopulated. The rings contain new employment centers, such as the booming Santa Fe corporate center. The city's directional bias has not been studied, but it is likely that some of its direction is toward these expanding rings, rather than either the CBD or the poverty-stricken outer periphery. More directional bias studies would be helpful in examining many developing-world cities.

Research on directional bias ideally requires an inventory to be kept of the origins and destinations of all residential moves for a particular area and time period. Neither the U.S. Census Bureau nor state or local governments are likely to be able to gather this information because respondents would object. The Internal Revenue Service might have some of the information, but is prohibited from utilizing it for studies. Because of lack of data, the technique has not been widely used by city and regional planners. With better information sources, it would become a useful planning tool because it sheds light with fine detail on the directional mobility trends within cities.

6.5 ANALYZING AN URBAN ISSUE: ACCESSIBILITY INDEX IN LOS ANGELES

We have seen that an important aspect of residential mobility is accessibility, or how accessible a residential location is to jobs, schools, friends, and relatives. A closely related concept is how accessible offices, businesses, schools, government offices, and so on are to the people they serve. Rather than a residence, here the central point is a business, social, or educational site.

To analyze accessibility, the following basic information is needed:

- Spatial location of the base site where the residence, business, or other unit is located;
- Spatial locations of all the access points; and
- Measurement of the population associated with each access point.

Accessibility to such a base point can be analyzed by a method known as *population potential* (Geertman & van Eck, 1995; Handy & Niemeier, 1997; Liu & Zhu, 2004). The formula for population potential is

$$v_j = \sum_{i=1}^{r} (P_i/d_{ij}) \qquad (1)$$

where population potential v_j at any base site j is found by first computing the population, P_i, of every subarea i in the study area and dividing by the distance d_{ij} from its centroid to the base site. Then these ratios are summed up for all r subareas, $i = 1, 2, \ldots, r$. The *centroid* is the average of the x,y coordinate points for a zone, based on some characteristic.

Thus, if there is a large population with access to a site, but it is nearly all far away, this formula will considerably diminish the impact of the population on the site.

A simple use of population potential would be to decide where to locate a pizza parlor in a small city. Population potential could be calculated for 10 different prospective sites, chosen on the basis of other criteria such as transport and zoning. The one with the highest population potential would have top priority to be chosen.

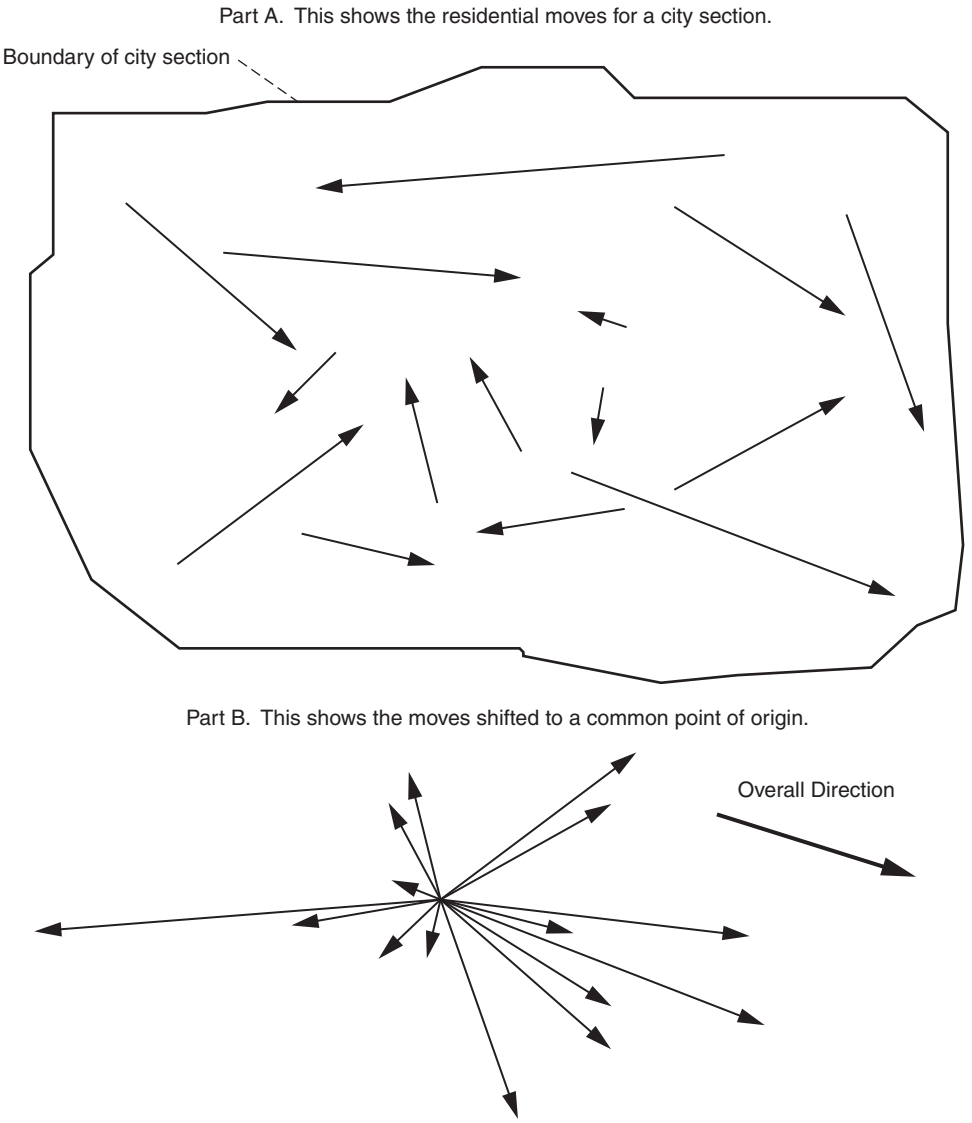

Part A. This shows the residential moves for a city section.
Boundary of city section
Part B. This shows the moves shifted to a common point of origin.
Overall Direction

FIGURE 6.12 Hypothetical residential moves in a section of Portland, Oregon. *Source*: Clark, William A.V. 1986. HUMAN MIGRATION. Copyright 1986 by Sage Publications Inc. Books. Reproduced with permission of Sage Publications in the format Textbook, Other book and Presentation via Copyright Clearance Center. Fig. 2.1a. P. 30. "A sample of household moves in the San Fernando Valley of Los Angeles." Fig. 2.1b. "Samples of moves from Figure 2.1a plotted with common (hypothesized) origin."

The urban issue for this chapter applies population potential to determine the best among four potential building sites in Los Angeles on which to locate a center for environmental education for community clients largely from an ethnic minority population. Because the center serves a disadvantaged population, the population potential is calculated on the basis of minority population only. This chapter's ArcGIS exercise explains further how the four population potentials are calculated. In the Google exercise, students can explore language and ethnic aspects of areas surrounding the sites.

For the exercise, making siting decisions on the basis of real-world data and robust methods is better than just siting such centers on the basis of a "seat of the pants" approach. A geographic information system (GIS) adds to the strength of the method, as it is possible to visualize the four sites and add in other layers, such as transport, terrain, high schools, environmental reserves, or protected zones.

More advanced accessibility analyses can add further refinements to the calculation of access. Among the other factors (Handy & Niemeier, 1997; Liu & Zhu, 2004) that can be taken into account for calculating access are the following:

- Characteristics of the transportation system;
- Timing of the activity (time of day or day of the week);
- Characteristics of the individual or group seeking the access;
- Types of activities occurring at the access points; and
- The rate of decline of the travel attractiveness with distance.

An example of a more advanced population potential problem would be the following. Fast-food restaurants are being located at 20 test sites to serve the Phoenix metropolitan area. A more advanced population potential will be calculated for each site. The population potential for a fast-food location in this market is known to decline by the square of the distance from a given site. Again, a population potential formula is used to estimate the population potential of each of the 20 locations. The formula is based on the number of customers at the location. The formula for this example of population potential is

$$v_j = \sum_{i=1}^{r} (C_i^* t_{ij} / d_{ij}^2) \qquad (2)$$

where the population potential v_j at any site j is found by first computing the number of customers C_i of every fast-food area i in the study area, multiplying it by the traffic ease-of-flow value t_{ij}, and dividing by the square of the distance d_{ij} from the study site to the base site.

As a population potential calculation gets more complicated, as seen in this example, the problems of data collection become more difficult. In a real-world planning situation, it is often better to stick with a simpler model because it is easier to understand. GIS is a great tool to use for estimating accessibility and population potential because the user can look at the spatial locations of the base site, access points, and transportation systems before, during, and after the analysis. The exercise keeps it fairly straightforward, utilizing the simple formula (1). After building and running the model and exploring neighborhoods around the site, in the essay question you evaluate the strengths and weaknesses of the model, and whether it makes sense to expand it.

6.6 MIGRATION PATTERNS AND TRENDS IN THE UNITED STATES AND AUSTRALIA

This part of the chapter explores recent trends in migration in the United States and Australia, especially during the 1990s. Both nations have had traditions of elevated internal migration. At the same time, their patterns are different, depending on contrasting economic, social, and geographic factors. The focus here is on the national patterns and how they affect cities and urban areas.

6.6.1 U.S. Internal Migration

The United States experienced high rates of interstate migration over the past quarter century. As seen in Table 6.2, about a fifth of Americans migrated to a different state every five years from 1975 to 1995, and another 4 to 5 percent of migrants were international migrants (Schachter, 2001). The overall rate of any type of movement was consistently about 45 percent.

Regionally, on a net basis, migrants left the Northeast and Midwest and moved to the South and West until the 1990s, when the West's net migration lowered to about the break-even point (see Table 6.3). Table 6.3 also shows large-scale net movement of population from the other three regions to the South. Those migration streams are large, as seen by the 1.6 million persons who migrated both from the Northeast to the South and from the Midwest to the South and the 1.5 million persons who migrated from the West to the South from 1990 to 1995 (Table 6.3). The shift to the South has continued more recently; for 2008 to 2009, 382,000 persons migrated to the South, while the West was nearly even with loss of 29,000 persons, and the Northeast and Midwest lost 170,000 and 183,00 persons respectively (U.S. Census Bureau, 2010f). This is consistent with the long-term trend of migration to the South discussed in Chapter 1, although the West's growth has slowed due in part to economic impacts of the Recession of 2007–2009. A consequence has been the movement of the nation's centroid of population (i.e., weighted mean center) from the Northeast to the Southwest. This is seen in Figure 6.13, which shows the center moving from south central Indiana in 1900 toward the southwest, reaching south central Illinois in 1950, and located in 2000 in south central Missouri.

Data from the U.S. Census Bureau, in a different series emphasizing migration over a 1-year period, demonstrated that singles and highly educated people are more likely to be interstate migrants (Bogue, Liegel, and Kozloski, 2009; U.S. Census Bureau, 2001). For instance, from 2004 to 2005, 7.2 percent of never-married singles migrated versus 4.0 percent of married people with a spouse present (Bogue, Liegel, & Kozloski, 2009). Also, from 2004 to 2005, 5.3 percent of those with a bachelor's degree

TABLE 6.2 Moving Rates in the United States, 5-Year Periods from 1975 to 1995

Migration Time Period	Population 5 Yrs. Old and Older (in 1,000s)	No. of Movers (in 1,000s)	Moving Rate (percent)				Percent of Movers with Previous Residence in			
			Total	Inter-county	Inter-state	From Abroad	Same County	Different County, Same State	Different State	Abroad
1976–1980	210,323	97,629	46.4	19.5	9.7	1.9	54.0	42.0	20.9	4.0
1981–1985	216,108	90,126	41.7	17.8	8.7	1.8	53.1	42.6	20.8	4.3
1986–1990	230,446	107,649	46.7	19.1	9.4	2.2	54.5	40.8	20.1	4.7
1991–1995	241,805	106,616	44.1	17.0	8.2	2.2	56.7	38.5	18.5	4.9

Source: U.S. Census, 2003.

TABLE 6.3 U.S. Migration Flows, In-migration, Out-migration, and Net Internal Migration by Region, 1990–1995 (Numbers in 1,000s)

	To Residence in 1995				
From Residence in 1990	Northeast	Midwest	South	West	Total Out-migration
Total in-migration	1,162	2,191	4,682	2,269	—
Northeast	—	387	1,586	505	2,478
Midwest	281	—	1,613	749	2,643
South	613	1,025	—	1,015	2,653
West	268	779	1,483	—	2,530
Net migration	−1,316	−452	2,029	−261	—

Source: U.S. Census, 2003.

migrated compared to 3.1 percent of those with less than a ninth-grade education (Bogue, Liegel, & Kozloski, 2009). The same age-range differences are evident for interstate migrants as for residential mobility; for example, 3.0 percent of children under 10 migrated to a different state in 2002–2003 compared to 5.4 percent of those in their 20s, whereas only 1 percent of those over 65 migrated (Schachter, 2004). Note that sometimes the U.S. Census measures migration over 5-year periods and at other times over 1-year periods, with higher migration rates for the 5-year durations.

Why Americans migrate also depends on their level of education. In the prior study, 2 percent of non-high-school graduates moved to a different state compared to 3.5 percent of people with graduate degrees (U.S. Census Bureau, 2001). Figure 6.14 shows the reasons for moving for intracounty movers and intercounty migrants in 1999, cross-classified by education. Less-than-high-school-educated migrants tended to do so three-quarters of the time for housing and familial reasons, whereas only 18 percent of those migrants reported

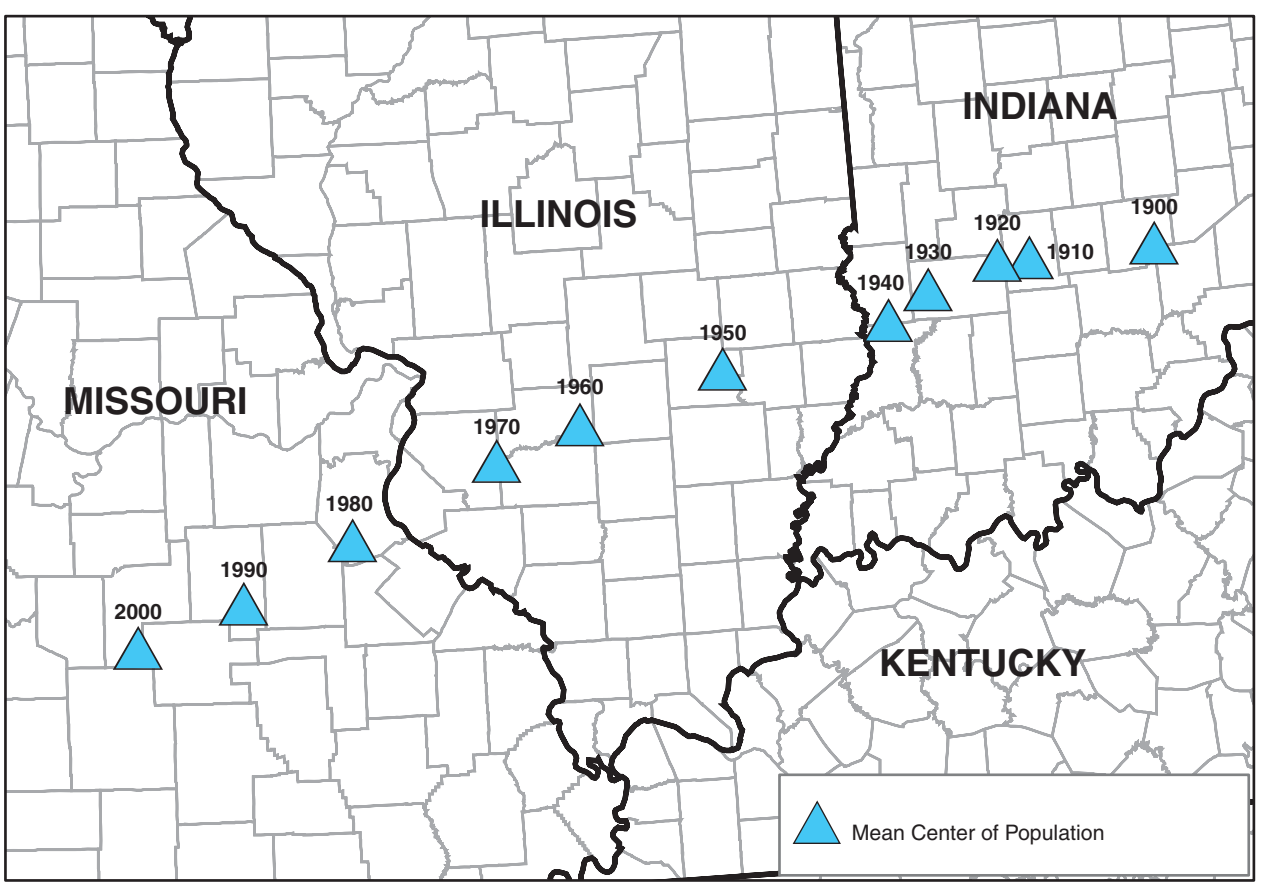


FIGURE 6.13 Shift in U.S. population centroid in the 20th century. *Source*: U.S. Census Bureau, 2010e.

work-related reasons. By comparison, for migrants with graduate and professional education, almost half of the migration was work-related. As discussed earlier, residential movers do so mostly for life-cycle reasons, as evident in the near 90 percent proportion of housing- and family-related reasons for them, regardless of education (Bogue, Liegel, & Kozloski, 2009). Work accounted for only 5 or 6 percent of intracounty moves. Economic reasons are more important for long-distance migrants because it is more likely for long-distance moves that migration is accompanied by a change in job, employer, or type of work.

To conclude, U.S. residential mobility and interstate migration from 2000 to 2005 remained steady at a high level and reflected the Sunbelt migration discussed in Chapter 1. Single, more educated, or young adults with accompanying young children were more likely to migrate. Migrants were economically motivated, especially for the highly educated. Domestic migration in the United States is discussed further in Chapter 7.

6.6.2 Australian National Migration in the 1990s

Australian migration is presented as a comparison and contrast to the United States. Like the United States, Australia is an advanced nation economically, but it differs in its topography, climate, world location (i.e., as a separate continent in the Southern Hemisphere), and system of cities. It is intended as an alternative example to the United States. The further contrast of internal migration and its effects on cities in a developing nation—China—is discussed in the last section. Australia is a large nation, nearly the physical size of the United States without Alaska, but its population is much smaller, at 21.3 million people in 2008. Australians are a very mobile population, like U.S. residents. As seen in Figure 6.15, the major metropolitan areas of Australia are located along the eastern and southeastern coastal areas. A total of 58.5 percent of the population is located in the southeastern states of Victoria and New South Wales, which include the nation's two largest cities, Melbourne and Sydney. This unusual distribution is the result of the bulk of the continent's interior being mostly inhospitable in terms of the climate and very dry.

Australia's internal migration system shows similarities to and differences from the American system. Australia has slightly higher residential mobility than does the United States, with 18 percent of its population changing residence in the year 2000–2001 (Hugo, 2003). In addition to its mobility, 27 percent of the Australian population in 2001 was foreign born, which is more than double the 11 percent for the United States (Australian Bureau of Statistics, 2003; U.S. Census Bureau,

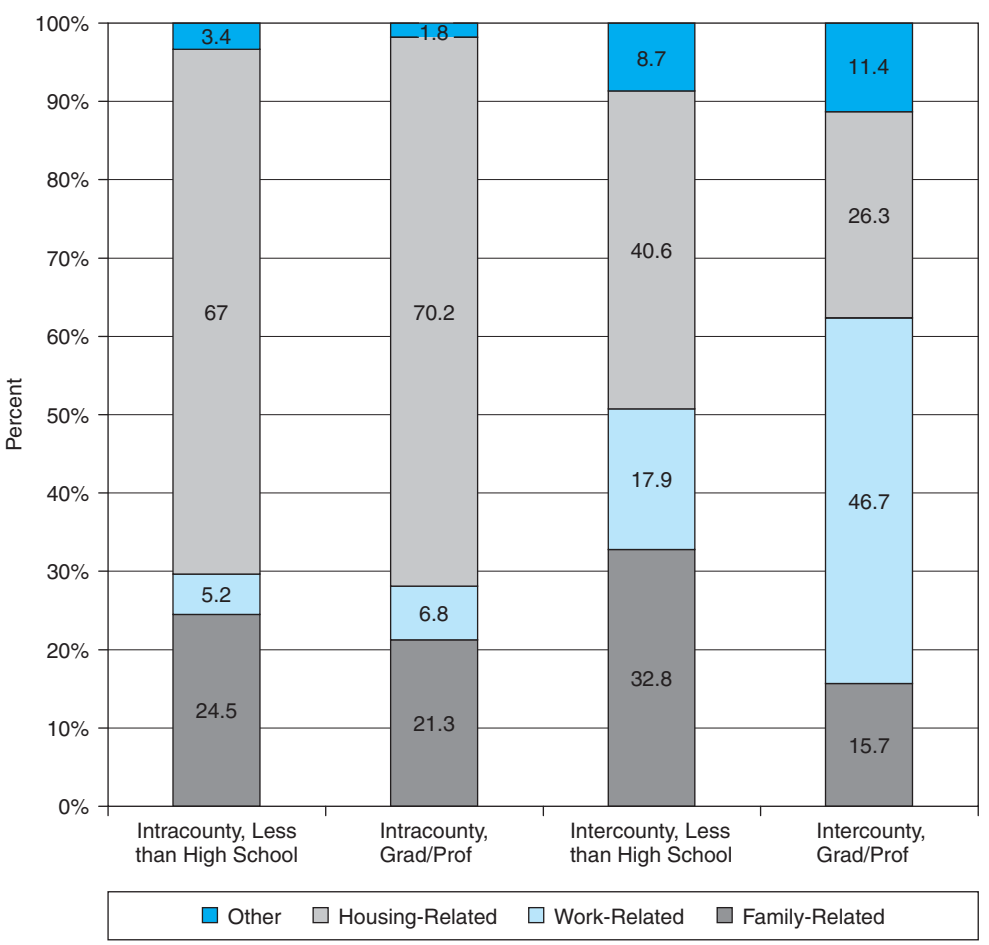


FIGURE 6.14 Moving reasons by educational level, United States, 2000. *Source*: Schachter, 2001.

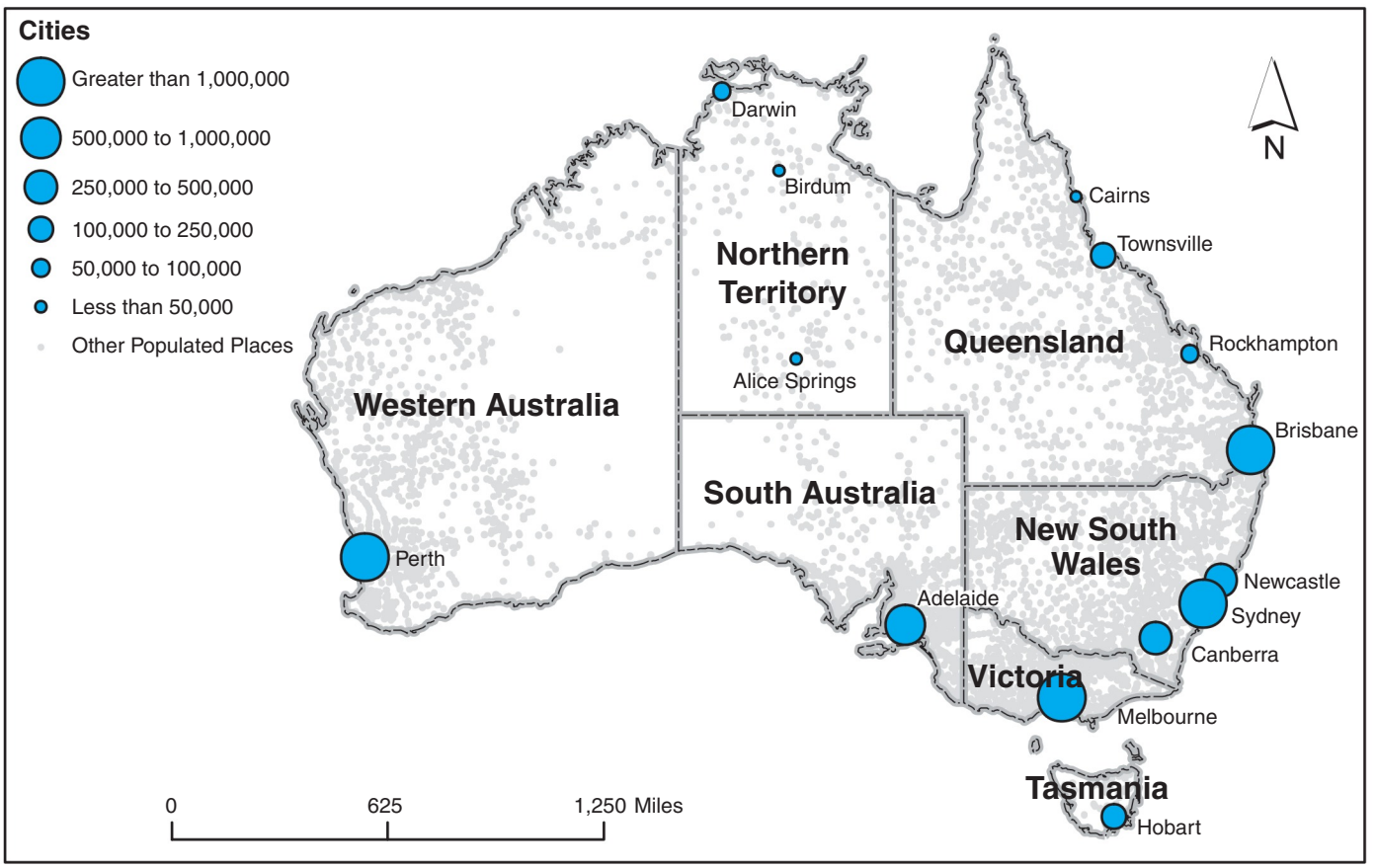


FIGURE 6.15 Australia and its major metropolitan areas, 2001.

2003). The foreign born come from a wide variety of nations, with the largest groups from Great Britain and Ireland combined at 6 percent of the total population, New Zealand at 2 percent, and Italy at 1 percent (Australian Bureau of Statistics, 2003). Over the past several decades, Australia has received more immigrants from large Asian nations, such as China and India, through push factors of weaker economies, perceived lower quality of lifestyle, and often fewer opportunities and freedoms in the sending nations; Australia's pull factors are the opposite to the push factors. Over the past several decades, the foreign-born immigrants have tended to settle in the biggest cities, Melbourne and Sydney, pictured in Figure 6.16 (Hugo, 2003). Many later move on to smaller cities.

Australia's geographic distribution of population has not changed much over the last 90 years. As seen in Figure 6.17, since 1911 the centroid location for the national population has remained relatively fixed in the center of the state of New South Wales. The location of this point only 300 miles from both Sydney and Melbourne demonstrates the continuation of the original settlement of Australia along its east and southeast coasts. Since 1911, the slight 65-mile shift in the centroid northward and slightly west reflects the more rapid growth of the northern state of Queensland and, to a lesser extent, the state of Western Australia. Queensland has grown because of its warmer climate and economic expansion, especially in tourism and related businesses.

From 1996 to 2001, Australia's growth was 1.3 million persons, relative to its 1996 population of 17.9 million. Fifty-six percent of the growth was from natural increase and 44 percent from foreign immigration (Australian Bureau of Statistics, 2003). Two-thirds of the 576,000 foreign immigrants settled in New South Wales and Victoria, the states of Sydney and Melbourne, and predominantly within those cities (Hugo, 2003). Vietnamese immigrants to Melbourne are shown in Figure 6.18.

The interstate migration flows from the 1996 to the 2001 censuses are seen in Figure 6.19 (Hugo, 2003, based on the Australian Bureau of Statistics, 2003). It shows all 42 interstate migration flows during this 5-year period. The width of an arrow is proportional to the size of flow. What is evident immediately is the location of major migration flows along the eastern flank of the country, not surprising as Australia's population is also concentrated in the east. There are large flows out of the populous state of New South Wales and, to a lesser extent, South Australia and the island state of Tasmania and into Queensland. The flow from New South Wales to Queensland is represented by the big northward arrow. Another important, but lesser, destination is the Perth area in Western Australia. Queensland, the northeastern state with the large city of Brisbane and growing tourism and development along its "Gold Coast," resembles in some ways Florida and the Southeast in the United States. Thus, the latest

FIGURE 6.16 Sydney: a Cosmopolitan City. *Source*: Getty Images, Inc.

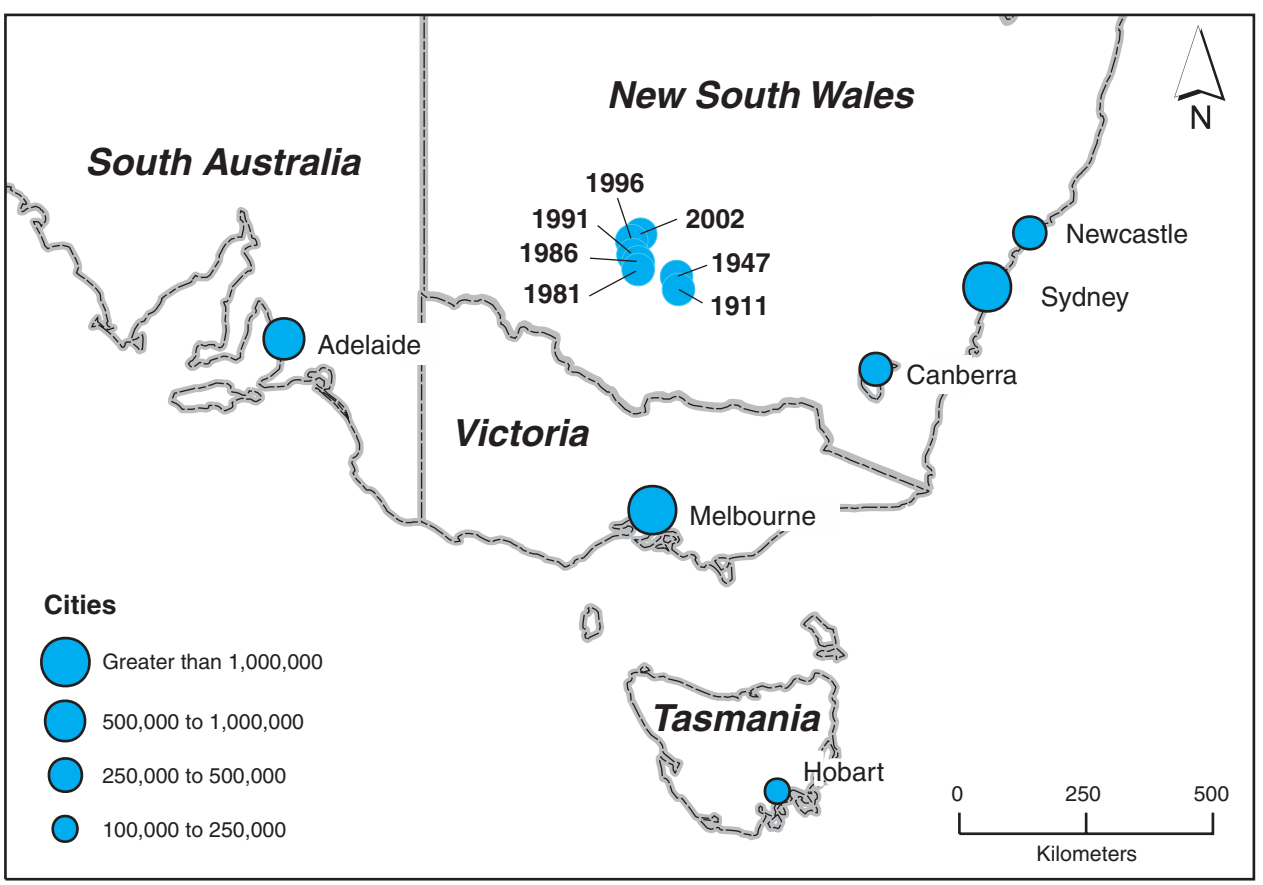


FIGURE 6.17 Shift in Australia's population centroid, 1911–2002. *Source*: Hugo, Graeme. "Recent Trends in Internal Migration and Population Redistribution in Australia." Paper presented at Meeting of Population Association of America, Minneapolis, Minnesota, May 2003. Reprinted by permission of the author. Figure 1. "Shifts in the Australian population centroid, 1911–2002."

FIGURE 6.18 Vietnamese immigrants to Sydney. *Source*: Black Star.

migration might parallel to some extent the U.S. movement away from the older, established cities into newer regions. One difference from the United States is that many foreign immigrants into the United States have flowed directly into the Sunbelt's "port of entry" cities such as Los Angeles, San Francisco, Houston, and Miami, whereas in Australia, the foreign immigrants have moved initially into the two most dominant, older, established cities, even as natives have tended to migrate to Queensland. The migration change in Australia's large metropolitan areas, known as metropolitan statistical divisions, from 1996–2001 is shown in Table 6.4, which indicates the greatest net migration loss from the older metropolis of Sydney and the greatest gain in Brisbane, which is in Queensland. Although the regional shifts appear large on the map, it must be remembered that they have only slightly altered the national population centroid over the last 90 years.

Another distribution that has not been greatly affected by the migration changes is metropolitan and nonmetropolitan settlement. Over the past 35 years, the main shift has been a sharp increase in the proportion of Australia's population in urban areas of 20,000 to 499,000, up from 12 percent to 19 percent, and a reduction of 2 percent in its very large cities and of 3 percent in its rural population. Although the 20th-century trend was to reduce the rural proportion, in the 1970s Australia experienced a decade of turnaround, with migration away from the urban areas. In the 1990s, rural-to-urban migration returned to about zero. Twenty-first-century shifts depend on the future environmental and amenity aspects of the largest cities, as well as on government investment in Australia's rural areas to make them more accessible. Because Australia is so large and lightly populated, it has not built up the necessary infrastructure to give modern transport access to much of its territory, especially the inhospitable interior regions (Hugo, 2003).

TABLE 6.4 Internal Migration 1996–2001: Australian Metropolitan Statistical Divisions

Statistical Division	In-migration	Out-migration	Net Migration
Sydney	175,732	233,685	−57,953
Melbourne	169,710	157,343	12,367
Brisbane	186,035	132,914	53,121
Adelaide	74,450	77,245	−2,795
Perth	100,290	89,695	10,595
Hobart	19,540	19,907	−367
Canberra	43,808	36,102	7,706

Source: Modified from Hugo, Graeme. "Recent Trends in Internal Migration and Population Redistribution in Australia." Paper presented at Meeting of Population Association of American, Minneapolis, Minnesota, May 2003. Reprinted by permission of the author. Table 14. "Metropolitan statistical divisions: internal migration 1996–2001."

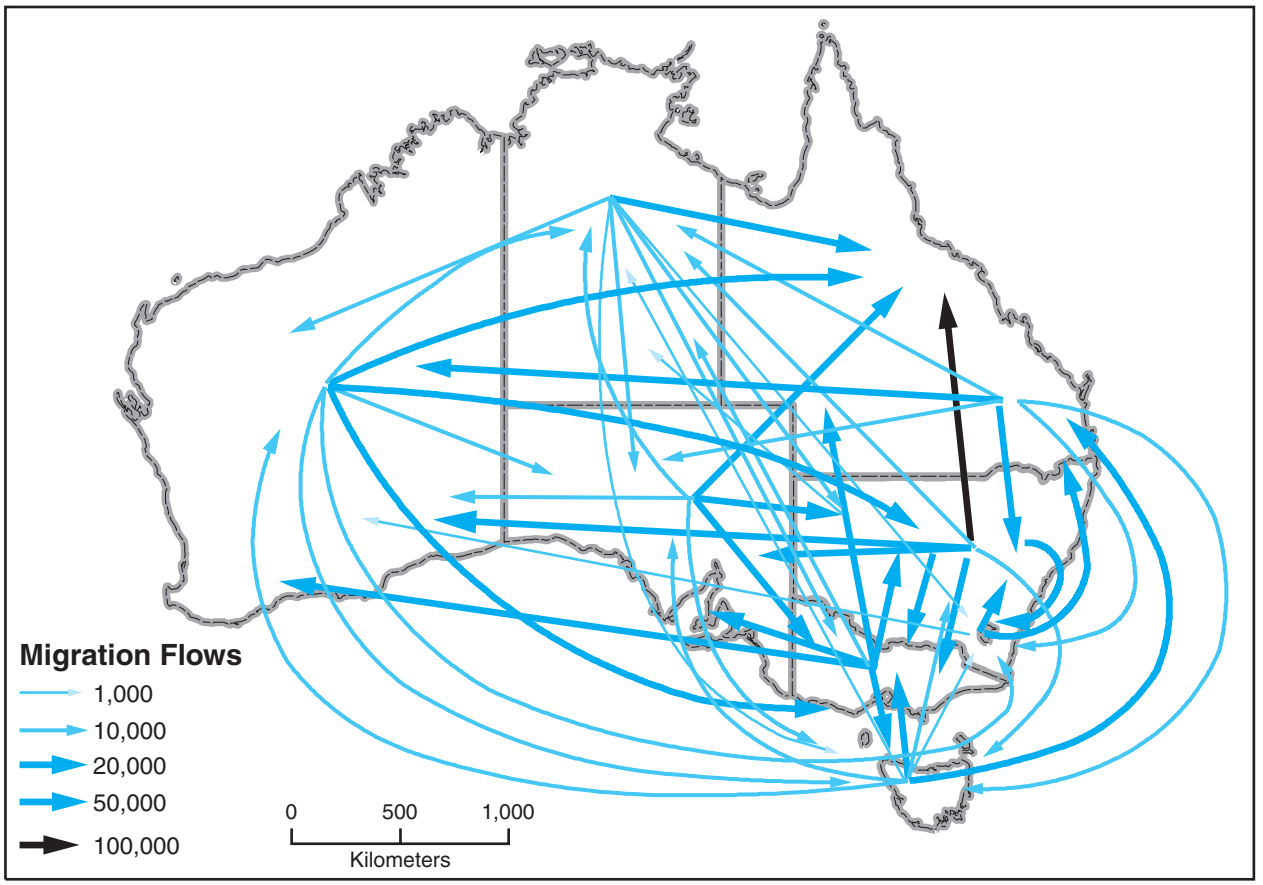


FIGURE 6.19 Australian interstate migration flows, 1996–2001. *Source*: Hugo, Graeme. "Recent Trends in Internal Migration and Population Redistribution in Australia." Paper presented at Meeting of Population Association of American, Minneapolis, Minnesota, May 2003. Reprinted by permission of the author. Figure 8. "Adelaide: percentage change in population between the 1976 and 1981 censuses."

What about the impact of Australia's migration patterns on its cities? The country's foreign immigrant population has settled in the large ethnic enclaves of Sydney and especially Melbourne. There are cultural and political ramifications of this ethnic minority settlement for a nation that before World War II experienced limited and mostly European immigration. For instance, there is a question of use of foreign languages in schools and the workplace versus English and the question of government support for poor minority immigrants. The political issue of foreign immigration has become part of the national debate, as it has in the United States and many European countries.

Queensland, which is growing especially quickly, needs to provide housing, services, government offices, and infrastructure. Politically, Queensland and Western Australia have increased in importance, as together they expanded from 21 percent of the national population in 1947 to 29 percent in 2001 (Australian Bureau of Statistics, 2003). This is analogous to the growing American political importance of Florida and the Southwest.

Hugo (2003) identified the following as the major factors affecting Australian migration: infrastructure, especially transport and communications; economic structural change; differences in housing and living costs; environmental issues; accessibility and remoteness of interior lands; and the migration patterns of Australia's baby boomers, who in 2011 are in the age range of 35 to 54. These resemble general factors covered earlier in the chapter for migration and mobility. They also resemble somewhat the factors noted for the United States, although the United States has greater transport accessibility and a more developed interior infrastructure and its boomers are about 10 years older.

6.7 INTERNATIONAL IMMIGRATION

Immigration, the migration of people into one nation from another one, has occurred in historical periods. For instance, Greeks migrated to Persia to support Greece's attempt to dominate it several centuries B.C., while Romans migrated to other regions in the expanding empire. More recently, Italians migrated in large numbers during the late 19th and early 20th centuries to Argentina. At the formation of Pakistan in 1947, numerous Muslim residents of postpartition India immigrated to Pakistan, and many Hindu residents immigrated from Pakistan to India.

International migration is important to urban geography because it influences the ethnic composition, population size,

and cultural features of cities. Immigrants from other countries tend to settle in cities because of job markets and social networks that might exist there, among other things. They contribute to forming neighborhoods, social and cultural organizations, and enterprises that shape the city and can lead to social cooperation as well as conflicts. The topic is built on further in Chapter 7 on ethnicity, Chapter 8 on industrial location, and Chapter 11 on aspects of planning.

Besides the impacts of immigration on the receiving countries and their urban areas, the sending countries can be impacted by labor losses, by family separations, and later by remittance payments sent home by migrants. This section gives an overview of the world immigration situation, followed by the U.S. situation and a discussion of immigration impacts. The next section details a case on immigration from the Dominican Republic to the United States.

The world has seen a large increase in international immigration: In 2005, international migrant stock totaled 191 million, representing 3.0 percent of the world's population (Martin & Zurcher, 2008; Population Reference Bureau, 2009). *Migrant stock* is population that has ever migrated from another country to the present country. The migrants have contributed workers, cultural customs and traditions, and childbearing to the receiving nations, whereas the sending countries have sometimes lost valuable workforce and productivity. At the same time, immigration has sometimes put burdens of welfare, support, and conflict on receiving nations.

The United States constitutes the largest destination of international migrant stock, with about 35 million in 2000—followed by the Russian Federation with 13 million, Germany with 7.3 million, and Ukraine with 6.9 million. Saudi Arabia's migrant stock of 5.3 million, in eighth place, is remarkable given its small population of 24 million. The presence of approximately 20 million migrants in Russia and Ukraine is partly explained by the breakup of the Soviet Union in the early 1990s, during which about 30 million new "immigrants" were created overnight from what had been internal migrants. Overall, according to the United Nations (2002), migrant stock totaled about 104 million in developed nations versus 71 million in less developed ones.

The highest proportions of international immigrants by percentage are in the Middle East, especially in the United Arab Emirates, Kuwait, Jordan, Israel, Oman, and Saudi Arabia (see Table 6.5). In these countries, immigrants are brought in to make up for shortages in the local workforce. Israel's recent migrants consist mostly of refugees from Russia, but earlier ones came from many countries in Europe, North Africa, and the Middle East—and some came from the United States. Russian immigrants to Israel are seen in Figure 6.20. As these Middle Eastern nations modernize, key questions involve the length of stay and adjustment of these immigrant populations, whether they achieve local citizenship, and the extent of return migration.

Another important factor for international migration is the remittances that migrants send back to their families in the homeland. This applies mainly to migration from developing to developed countries, where the wage scales are much higher than at the origin. The estimate of the World Bank for formal remittances was $150 billion in 2004 (Global Commission on International Migration, 2005). Mexicans in the United States, for instance, currently are sending back about $9 billion in remittances annually. For poor nations sending migrants, such as El Salvador, Nicaragua, Somalia, and Yemen, seemingly small remittances of several thousand dollars appear very large in the origin nation, often exceeding the mean annual income.

TABLE 6.5 Major Receiving Nations for International Immigration by Percent, 2000

Nation	Migrant Stock as a Percentage of Total Population
United Arab Emirates	73.8
Kuwait	57.9
Jordan	39.6
Israel	37.4
Singapore	33.6
Oman	26.9
Estonia	26.2
Saudi Arabia	25.8
Latvia	25.3
Switzerland	25.1
Australia	24.6
New Zealand	22.5
Gabon	20.3
Canada	18.9
Kazakhstan	18.7
Lebanon	18.1
Ivory Coast	14.6
Gambia	14.2
Ukraine	14.0
Belarus	12.6
Average for top 20 nations	27.5
Average worldwide	2.6

Source: United Nations. (2002). *International Migration Report* (Publication ST/ESA/SER.A/220). New York: Author.

Of worldwide international migrant stock, about 7 percent are refugees (United Nations, 2002). They are mostly located in Africa and the Middle East, followed by East Asia (U.S. Committee on Refugees, 2009).

We estimate that 75 percent of the 191 million migrant stock in 2005 are located in urban areas, commonly in larger cities. This implies both major benefits and major burdens. For instance, the large city might benefit from the low-skilled workforce and augmented multiculturalism. Another benefit for very developed nations is the ability to counter the population decline that is affecting most of them. This stems from the large decline in fertility that has occurred worldwide in developed nations, as well as in many developing ones (Population Reference Bureau, 2009). If deaths exceed births, as is now the case in many developed nations, to maintain an even population level the balance must be made up by net migration.

FIGURE 6.20 Russian immigrant family arriving in Israel. *Source*: Contact Press Images Inc.

Because the developed nations today are sending out relatively few emigrants, there must be at least some immigration to avoid population decline.

In spite of workforce and other economic needs, some countries are resisting large-scale migratory influxes. Consequently, today 44 percent of developed countries have established government policies to discourage in-migration, while 39 percent of developing nations have such policies (Global Commission on International Migration, 2005; United Nations, 2002). The policies were not often approved amicably, but involved political tensions and difficult compromises. Only 4 percent of nations have policies aimed at increasing immigration (United Nations, 2002); these include several European nations such as Italy that are confronting the potential of population decline (Global Commission on International Migration, 2005). In the post-9/11 world, security concerns add further to restrictive policies on immigration.

6.7.1 Immigration in the United States

The United States has international immigration policies that date back to before the founding of the Republic (Frey, Abresch, & Yeasting, 2001). The forced immigration of slaves to the United States is considered in the next chapter on ethnicity. As seen in Table 6.6, the United States at its beginning granted widespread citizenship to free White people, while also importing many nonfree Blacks. Until after World War I, the doors were largely open to foreign immigrants. The initial groups immigrating came from northern Europe—Britain, Ireland, Scandinavia, Germany, and the Netherlands. Late in the 19th century, they were replaced mostly by southern and eastern Europeans—Italians, Poles, Russians, and Jews from many countries—and some Chinese and Japanese. Figure 6.21 (on page 193) pictures European immigrants arriving in the United States. In 1882, the Chinese Exclusion Act was passed, restricting Chinese immigrants on the basis of ethnic origin, the first such act in the nation's history. From the beginning of the United States to 1922, the great majority of immigrants from Europe to the United States moved from rural areas in their origin nations to settle in cities in the United States. Beginning in 1917, Blacks in the South, mainly from rural areas, replicated this European pattern by migrating to northern cities. This contrasted with immigration before the American Revolution, which was mainly to rural areas.

During the 20th century, there were fluctuating policies of openness and closed doors, ending up with the elimination of the quota system in 1965, which specified that nations would bring in the same number of immigrants each year. This started a wave of immigration that grew in the last third of the century to reach nearly a million immigrants entering per year in the 1990s. There were so many Mexican immigrants arriving and living undocumented in the country that in 1986 Congress passed the Immigration Reform and Control Act. It provided amnesty to millions of undocumented immigrants in the United States, but at the same time toughened illegal immigration controls. After amnesty took effect, the illegal immigrant controls have had limited success, and the immigration streams from Mexico, in particular, have fallen only slightly.

TABLE 6.6 Major Milestones in the History of U.S. Immigration Since 1790

1790: Start of naturalization. Immediate citizenship was granted to free White persons who had resided in the United States for two or more years.

1882: Chinese Exclusion Act. This stopped the immigration of Chinese. This was the first instance of the United States restricting immigration based on race.

1921: Quota system started. Its principal purpose was to limit migration from Eastern Europe. Annual immigration was limited to 3 percent or less of the 1910 population of the country of origin.

1965: Quota system eliminated. Instead, every country was allowed to send the same number of immigrants annually, based on the number who were in the United States at the time of the 1910 Census. Exception: Several nations in the Western Hemisphere were permitted to have unlimited immigration.

1986: Immigration Reform and Control Act (IRCA). The act gave amnesty to millions of illegal immigrants. It included strong steps to combat illegal immigration.

1996: Illegal Immigration Reform and Immigrant Responsibility Act. The act reinforced government agencies that reduce illegal immigration and removed the public-benefits rights of immigrants who are legal.

2010: Continuing large legal and illegal immigration, totaling 1 to 1.5 million annually. Mexican immigration slowed.

Sources: Immigration and Naturalization Service. (2002). *2000 Statistical Yearbook of the Immigration and Naturalization Service.* Washington, DC: Author; Passel, J. S. (2006)."Size and Characteristics of the Unauthorized Migrant Population in the U.S." Report. Washington, DC: Pew Hispanic Center.

One estimate in 2006 was that 770,000 unauthorized foreigners entered the United States that year, with a total of 11.5–12 million unauthorized foreigners resident in the country (Passel, 2006). Since 2006, the immigration of Mexicans to the United States has slowed, although emigration of Mexicans from the United States back to Mexico has remained steady, and the total number of Mexicans resident in the United States has remained nearly the same (Passel & Cohn, 2009). In 2008–2009, the *Instituto Nacional de Estadísticas, Geografía, e Informática* (INEGI; Mexican Institute of Statistics) estimated that 617,000 Mexicans left the country for the United States, a 38 percent decline from 2006–2007 (INEGI, 2010). The drop is ascribed to a combination of stepped-up border enforcement and the recessionary U.S. economy (Passel & Cohn, 2009).

In recent years, about 600,000 legal permanent immigrants have been admitted to the United States yearly (Martin & Zurcher, 2008). As seen in Table 6.7, they were admitted mostly for purposes of family reunification, although employment and refugees or asylum seekers were also important. In addition, there are huge numbers of temporary visitors, students, and workers to the country—about 14 million each year. The result of recent decades of immigration has been the presence of a huge foreign-born population in the United States, totaling 37.7 million in the period 2006–2008 (U.S. Census Bureau, 2010a). This foreign-born population is largely located in metropolitan areas. For instance, during the 1990s, 4.9 million immigrants arrived in 10 major metropolitan areas in the United States (see Table 6.8). The largest of them—the seven "port of entry" metropolitan areas of New York, Los Angeles, San Francisco, Miami, Chicago, Washington, DC, and Houston—together accounted for 4.4 million immigrants. As a consequence, those cities developed large ethnic communities,

TABLE 6.7 U.S. Immigrants and Temporary Visitors, 1995–2000

Category	Number (in 1,000s)	Percentage
Immigrants		
Family reunification	3,121	68
Employment	535	12
Refugees and asylees	516	11
Domestic diversity	292	7
Other	108	2
Total immigrants	4,572	100
Temporary visitors and students		
Visitors for business or travel	130,643	91
Students and their families	2,757	2
Temporary workers, trainees, and families	2,223	2
Other	7,171	5
Total temporary visitors and students	142,794	100

Source: Immigration and Naturalization Service. (2002). *2000 Statistical Yearbook of the Immigration and Naturalization Service.* Washington, DC: Author.

TABLE 6.8 Number of Immigrants Arriving in 10 Major U.S. Metropolitan Areas, 1990–1999

Metropolitan Area	Number of Immigrants Arriving 1990–1999
New York	1,408,543
Los Angeles	1,257,925
San Francisco	494,189
Miami	420,488
Chicago	363,662
Washington, DC	267,175
Houston	214,262
Dallas–Fort Worth	173,500
San Diego	159,691
Boston	137,634
Total	4,897,069[a]

[a] This total represents more than 60 percent of all immigrants arriving.

Source: Copyright © 2001 AMERICA BY THE NUMBERS: A FIELD GUIDE TO THE U.S. POPULATION by William Frey, Bill Abresch, and Jonathan Yeasting. Reprinted by permission of The New Press. www.thenewpress.com. P. 51. Unnumbered Table. "A history of migration."

FIGURE 6.21 European immigrants arriving in the United States at the turn of the 20th century. *Source*: Library of Congress.

needed to bolster their service and support systems, struggled to provide education, expanded ethnic events, and experienced more frequent political changes. Another important aspect has been the formation of diasporas (see Table 6.9). A *diaspora* (scattering) refers to that part of the population of a country of origin that has migrated overseas. Mexico's largest diaspora today is located in the United States; it was estimated in 1997 at 7 million, with several million more today (Passel & Cohn, 2009). This and other diasporas retain connections to the home country; for instance, in communications and visits to the homeland, the sending of remittances, and sometimes even the retention of voting rights from the country of origin.

TABLE 6.9 Large Proportional Diasporas in the United States, 2007.

Country	Country's Foreign-Born Population in the United States, 2006–2008 (in 1,000s)	Population of the Origin Country, 2007	Ratio
Jamaica	623	2,782	0.224
El Salvador	1,077	5,972	0.180
Belize	46	297	0.156
Mexico	11,478	108,701	0.106
Dominican Republic	763	9,366	0.081
Haiti	523	8,711	0.060

Sources: U.S. Census Bureau. (2010a). *Selected Population Profile in the United States: American Community Survey 2006–2008* (Tabulation S0201). Washington, DC: Author. U.S. Census Bureau. (2010b). *International Data Base*. Washington, DC: Author.

6.8 TRANSNATIONAL IDENTITIES

Immigration brings about mixed identities. *Transnational identities* refer to identification of immigrants with their countries of both origin and destination. A broader concept is that of *transnationalism*, which refers to the in-betweenness and ambivalence of national identity for people, organizations, and places. An example is an immigrant family that arrives in the United States from Brazil. The family learns and participates in the new customs and traditions of the United States, but maintains some Brazilian cultural tradition. Within the family, different members might have different extents of transnational identity. If, after arrival, a new child is born in the United States, he or she will be raised with an identity more American than Brazilian, whereas the non–English-speaking grandmother who came with the family has a transnational identity that is much more Brazilian than American. Today, because the United States has the highest level of foreign-born population in 80 years, reaching 12.5 percent in 2006–2008, the issue of transnationalism is a prevalent one (U.S. Census Bureau, 2010a).

Over the generations, transnational identities change (Portes & Rumbaut, 2006). Assimilation processes often encourage adoption of the traditions of the new culture and the destination language. However, in other cases, the transnational

identity persists, and full assimilation does not occur. Assimilation is controversial—it might or might not be advantageous. Some urban political geographers emphasize the benefits of remaining unassimilated, pointing to social, cultural, and economic reasons.

The economic context of transnational identities is important. In the broad context, the identities of many immigrants are economically driven. They might retain certain ties with their homeland, or have stronger involvements at the destination, due to economic advantages. Globalization trends discussed in Chapter 4 have encouraged the economic aspects, due to the increased flows of capital and people worldwide. Because of the historical factors of immigration and culture, transnational identities are different among ethnic groups and can differ by gender (Mitchell, 2003). In communities on the border between nations, transnational identity is often more prominent and more persistent (Arreola, 2002). Assimilation toward only one national identity might be precluded along international borders, where residents are enmeshed every day in both cultures.

A brief example illustrates the basic concepts, as well as differences, in transnational identities, and the next section on Dominicans in the United States explores this topic in greater depth. The example here is transnational identity in the border city of Laredo, Texas. This city of 215,484 people in 2006 is a rapidly growing major trucking port of entry for the United States. It has a sister city in Mexico, Nuevo Laredo, with which it was joined until 1848. Laredo has one of the highest proportions of Hispanic population (94 percent) among U.S. cities. There are not problems of discrimination and resentment because of the dominant majority. In fact, Anglo residents of Laredo tend to assume some Mexican traits (Arreola, 2002). Residents of Laredo identify culturally with both the United States and Mexico (Arreola, 2002). There are many families that have extended across both Laredos for generations. Not only do about 95 percent of the residents speak Spanish, but also residents of Laredo, Texas, are heavily dependent economically on Mexico, which provides shoppers and international trucking business. These aspects are long term, even though the sister cities have been impacted in the 2000s by the economic recession and drug violence. In sum, the transnational identities of residents of Laredo are strong and persistent over time, stemming from a mixture of history, language, border proximity, and familial and economic ties (Arreola, 2002).

6.9 IMMIGRATION IMPACT ON A CITY: DOMINICANS IN NEW YORK CITY

Immigrants from the Dominican Republic constitute one of the fastest-growing groups in the United States. In 1990, there were 347,858 U.S. residents born in the Dominican Republic; this number leaped to 763,000 in 2006–2008 (U.S. Census Bureau, 2010a). Among Hispanic groups in the United States, Dominicans in 2010 were third, as measured by country of foreign birth, behind Mexicans and Cubans. The size of this in-migration has made the Dominican migration to the United States a major diaspora group. Dominican-born people in the United States were equivalent to almost 8.1 percent of the remaining population of the Dominican Republic homeland (U.S. Census 2010a; U.S. Census 2010b), a percentage over two percent less than the corresponding value for Mexico and lower still than the top three diaspora nations to the United States.

The Dominican Republic as origin country provided "push" factors leading partly to this large exodus. It is a developing country of 9.8 million people that shares an island with Haiti (U.S. Census 2010b). It has a mixed agricultural economy involving coffee, sugar, and tobacco, combined with tourism. The economic situation in the Dominican Republic has fluctuated for several decades, suffering at times in the 1970s and 1980s and in recent years. The push has stemmed from those privations. Although in the 1990s the Dominican economy had a very fast growth rate, it was dampened by huge economic losses from Hurricane George in 1998. The United States and its vast labor markets formed a pull factor. As more and more Dominicans have settled in the United States, there is additional pull from the presence of this large social network.

Dominican migrants to the United States have tended to be from urban areas with low education by U.S. standards, although some have been better educated, and even well off. However, once they arrive in the United States, the educational levels of their offspring often drop to a relatively low level. Most Dominicans have entered the United States illegally, commonly by having false documents or overstaying a tourist visa (Grasmuck & Pessar, 1996). In some cases, such overstayers planned to return when events improved in the origin nation, but often this did not happen, and a temporary visit turned into a long stay and eventually naturalization.

Dominicans have predominantly settled in New York City or northern New Jersey. As pictured in Figure 6.22 and mapped in Figure 6.23 for New York, they have settled mostly in Manhattan's Washington Heights, in nearby areas just to the east in the Bronx, in Queens just to the south of La Guardia Airport, and along the Brooklyn–Queens boundary, mostly just to the southwest in Brooklyn. They have added their own flavor and cast to these areas, especially sections of Queens, where there are Dominican restaurants, cultural events, magazines, and other media (Grasmuck & Pessar, 1996).

However, in adjusting to their new country, many of the first-generation Dominican immigrants have suffered from family disorganization, job discrimination, and low-income jobs that were mostly menial. This low status stems from their relative lack of skills for the competitive U.S. job market. The immigrants have gravitated toward low-paying jobs, mostly in retailing and services, including work in hotels and restaurants and, for women, in the garment industry, domestic work, cooking, and teaching (Grasmuck & Pessar, 1996; INSTRAW, 2010). Their income has averaged about one-third of the U.S. average, with an extraordinary poverty rate of 30 percent, about three times the U.S. average (INSTRAW, 2010). This poverty stems from lack of relevant skills for the U.S. workplace; for instance, about 49 percent of Dominicans over 25 years old had not finished high school in 2000 (Hernández & Rivera-Batiz, 2003).

The situation has led to a high divorce rate and family disorganization. For example, in 2000, 38 percent of Dominican

FIGURE 6.22 Census enumeration in a Dominican American area of New York City. *Source*: The Image Works.

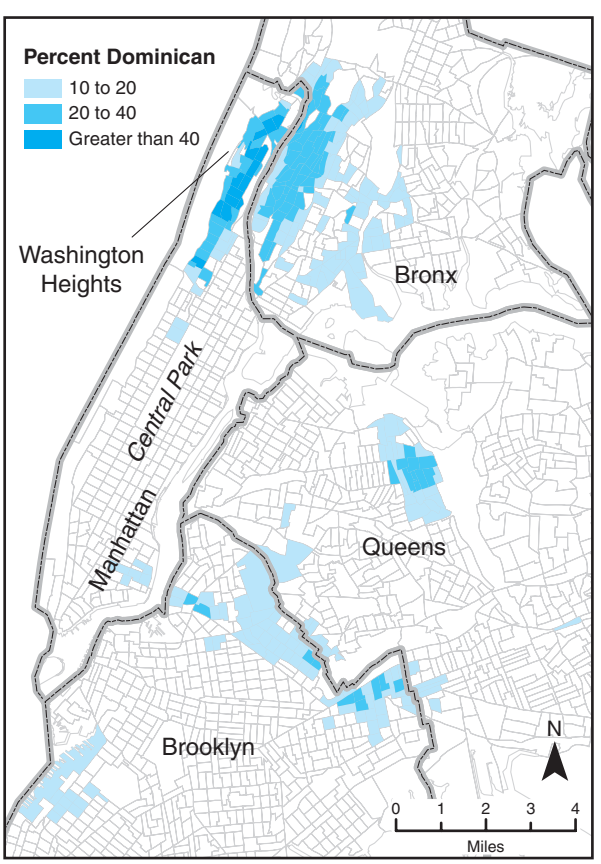


FIGURE 6.23 Dominicans in New York City, 2000.

households in poverty in New York City had a single female parent. Family breakdown tends to perpetuate poverty, often into the second generation. At the same time, however, some women who have gained employment in this process have experienced a feeling of liberation, albeit at a low occupational level (Grasmuck & Pessar, 1996).

Another adverse factor is the high proportion of Dominicans lacking English-speaking ability. The proportion of Dominicans speaking substandard or no English was more than 50 percent for immigrants in the late 20th century, which compared to 10 percent for Dominicans born in the United States (Grasmuck & Pessar, 1996). This serves as a major impediment to the advancement of Dominicans in their new country. At the same time, a positive sign for immigrants is the low, but increasing proportion, of college graduates in this group, which signifies that more-educated people are leaving the homeland, although the proportion is still quite low. The college graduation composition for Dominican immigrants rose from 4.5 percent in the late 1960s to 11.3 percent in the late 1980s (Grasmuck & Pessar, 1996). As with other immigrant groups, the second generation has a nearly 100 percent rate of English speaking. However, so far, the arrival of ever-increasing immigrant streams has maintained a low overall average of English-speaking performance.

Other aspects of the adjustment process for Dominicans include overcoming racial discrimination, establishing their ethnic identity, deciding whether to be self-employed, and continuing social and economic ties with the homeland (Grasmuck & Pessar, 1996). One of the differences of

Dominicans compared to some other entering Latino groups is that many have an African background. In census self-attribution, only about a quarter identified themselves as White, with 50 percent choosing mixed race and 25 percent Black. As a result, many Dominicans have experienced discrimination against Blacks in addition to anti-Latino discrimination. The dual-race factor has influenced their lack of success in New York City, including in the housing and employment markets.

A related issue is that of transnational identity. As with any immigrant, does the Dominican resident identify himself or herself with the homeland, with Latino culture in the United States, or with Black identity? A person's working through this over time might lead to personal satisfaction, but sometimes also to neighborhood and work tensions and conflicts.

As with some other immigrant groups, Dominicans have shown a tendency to opt for self-employment, and especially to start small, ethnic-based concessions and businesses (Grasmuck & Pessar, 1996). The problem is the riskiness of succeeding in a competitive metropolitan market, and again there is a high rate of failure. Nevertheless, this might offer them more hope than being bogged down in low-level service jobs.

Dominicans have maintained close ties with their homeland, stimulated by the large diaspora factor. For instance, a large proportion of immigrants send remittances to family members in the homeland. Even though these immigrants are mostly poor by U.S. standards, the money they send has much more relative value back in their home nation. Estimates indicate that as much as 25 percent of Santo Domingo residents are receiving remittances (Grasmuck & Pessar, 1996), and 71 percent of adult Dominicans in the United States regularly send remittances (INSTRAW, 2010). In summary, this case example points to a complex process of immigrant adjustment to a new country. It has not been an easy road for Dominicans, or for most immigrants in the United States, yet many among the second generation have gained more education and skills and been able to move up from their poor beginnings. Ties with their homeland help in maintaining identity, and immigrants provide a source of revenue to send back to the mother country. There has been a major urban impact, especially on social, cultural, neighborhood, and service sectors in New York City.

6.10 RURAL-URBAN MIGRATION AND CHINA'S CITIES

This last section examines internal, rural-to-urban migration in the developing world, which was seen earlier to characterize nations especially during their development phase. This case involves the world's most populous nation, China, which had a population of 1.331 billion in 2009 (Population Reference Bureau, 2009). Rural-to-urban migration has created an urban component known as *floating population* (Lu, 2009). This population consists of rural-to-urban migrants who have arrived in China's urban areas, but have not gained a permanent residency permit; hence, they have restricted or no papers and are referred to as floating. The floating population numbers 150 million, which constitutes about a quarter of the nation's urban population and is in the population range of Japan or Russia. Figure 6.24 shows Chinese rural migrants working in a city.

This case demonstrates that migration patterns can vary for nations at different development levels and with different types of government regimes. The case forms a major contrast to the open, free, and unregulated internal migration in the highly mobile United States and Australia. It also provides an example of rural-to-urban migration, which is prevalent in the developing world today, but also was a major cause of growth in U.S. and European cities over the last two centuries. China's floating population constitutes a major national social problem that will lead to discontent, resentment, crime, and conflict unless it can be better planned and provided for.

This situation arose historically based on a national residential registration system known as *hukou,* which was established in 1951, but has been weakened, although not ended, in the past two decades by China's thrust toward a market economy. Under the Communists, China underwent a series of periods of supporting and withdrawing support for urban development. From 1952 to 1965, China emphasized urban industrialization, and consequently most of the cities grew, some explosively. With the advent of the Cultural Revolution in 1966, Chinese leaders emphasized the forced return of large numbers of mostly educated urban residents, who supposedly had taken on Western ways, to the rural areas to learn to be true Communists. The cities languished without much support. Since 1978, China has emphasized new economic reforms. It has opened up a market economy, increased agricultural efficiencies, and adjusted trade policies sufficiently to gain admittance to the World Trade Organization. However, better agricultural efficiencies have caused many farm workers to depart and seek low-skilled jobs in cities. At the same time, the loosening of central control has enabled the large cities to become somewhat more autonomous and exert greater control over their residents.

All these changes led to rapidly expanding Chinese urbanization (see Table 6.10). The urban population grew from 144 million in 1970 to an estimated 612 million by 2009 (Population Reference Bureau, 2009). In fact, the urban population growth over those 38 years approached 1.5 times the entire U.S. population. Likewise, there has been growth in the number of million-plus urban agglomerations, from 15 in 1980 to 107 estimated for 2010 (Song & Zhang, 2002; United Nations, 2008).

The case demonstrates connections among migration, urbanization, and industrialization that relate generally to nations undergoing economic development. As cities grow and industrialize, their job markets demand labor that exceeds what is available locally or what can be provided through natural increase. Migrants are attracted to the expanding job markets and settle there, which draws population from rural to urban areas, causing the country to become more urbanized. The introduction to these complex processes will be elaborated on in Chapter 9 on industrial location.

The *hukou* registration system was started for cities in 1951 and became a permanent system for both cities and rural areas in 1958 (Chan & Zhang, 2003). It has two parts: (1) A resident is officially registered into a permanent residence location, which he or she is limited to except for special reasons, and (2) the resident is assigned an agricultural or nonagricultural designation.

FIGURE 6.24 Rural migrant metal workers in a Chinese city. *Source*: Peter Arnold, Inc.

Until the loosening of this system in the early 1990s, there was strict enforcement of registration, and persons not living at their registered location were returned to their registered place. Since 1992, however, the system has loosened by including exception categories that enable certain rural migrants to gain more or less long-term residence in cities (Chan & Zhang, 2003). For instance, starting in 1992, one of the exceptions to traditional *hukou* was the Blue Stamp *hukou,* which determines eligibility for city residence based on the migrant's contributions to the urban economy. At the root, the exceptions stem from the developing market economy, which requires mobile labor. In spite of this opening up, the *hukou* system remains partly in effect today, constraining somewhat rural-to-urban migration.

Another reason for the *hukou* system is rooted in the Chinese government's long-term favoritism of the industrial over the agricultural sector. This has contributed to higher wages and more attractive jobs in industry and to an artificially wide differential between industry and agriculture. This is sometimes termed the "dual economy" or "dual society" (Chan & Zhang, 2003). As seen in Table 6.11, urban industry

TABLE 6.10 Urban Population of China, 1952–2009

Year	Total Population (in millions)	Urban Population (in millions)	Average Yearly Growth Rate in Urban Population	Urbanization (%)
1952	574.8	71.6		12.5
1962	672.9	116.6	4.88	17.3
1970	829.9	144.2	2.66	17.4
1980	987.0	191.4	2.83	19.4
1990	1,143.3	301.9	4.56	26.4
1999	1,259.1	388.9	2.81	30.9
2009	1,331.4	612.4	4.54	46.0

Sources: Song, S., and Zhang, H. K. (2002). "Urbanization and city size distribution in China." *Urban Studies* 39(12):2317–2327; Population Reference Bureau. (2009). *World Population Data Sheet*. Washington, DC: Author.

TABLE 6.11 Dual Economy and Dual Society in China (Up to the Early 1980s)

Dual Economy	
Urban Industry	**Agriculture**
Priority sector	Nonpriority sector
State owned	Nonstate owned
State supported and controlled	Self-reliant
Monopoly driven	Provides cheap resources to state sector
Dual Society	
"Nonagricultural" Households	**"Agricultural" Households**
Subject to political stability and control	Self-reliant, with less central control
Employment and welfare provided by state	Employment and welfare based on local collectives
Restricted entry	Tied to farming and land

Source: Chan, Kam Win and Li Zhang. 2003. "The Hukou System and Rural-Urban Migration in China: Processes and Changes." Working Paper. Seattle: Department of Geography, University of Washington. Reprinted by permission of Kam Win Chan. P. 14. Table 3. "Dual economy and dual in the pre-reform era."

not only receives a lot of state support, but was also traditionally state- or local-government owned, although some of it is slowly being privatized. In the dual society, urban households are under government control, which gives them more stability, but also restricts residence, whereas rural households are self-reliant and not subject to much government control. Local collectives provide the employment and support to rural workers. This dualism has been somewhat weakened, although not eliminated, by the market economy. Government control of urban areas and industries is not as tight as it used to be, and rural areas have some other options available. On the latter point, China's government has made attempts over many years to provide jobs for displaced farm workers through rural industrialization. However, those programs have largely failed, and the migrants continue to go to the middle-sized and large cities.

What have been the characteristics and experiences of rural-to-urban migrants? A study has indicated that the motivation of rural migrants to go to cities is mostly business or factory work (37 percent), job transfer or job assignment (15 percent), and marriage (22 percent) (Liang, Chen, & Gu, 2002). Clearly, economic pull reasons dominate, and marriage is second. Comparing the rural migrants to those who stay (see Table 6.12), the movers are younger, more likely to be single, and better educated; gender is not a distinguishing trait. This is consistent with the chapter's migration principle that younger, unmarried persons are generally more inclined to move. Also, because they aspire to city jobs in industry, education and skills are a big plus. A geographic aspect of this migration is that the destinations are predominantly on China's prosperous east coast, especially the large cities in the southeast. There new free economic zones continue to be developed on a large scale, with labor demand that the local workforce alone cannot come close to satisfying.

TABLE 6.12 Characteristics of Chinese Internal Migrants versus Nonmigrants

	Migrants	Nonmigrants
Male	51%	52%
Age	28	33
Single	36%	25%
Illiterate	9%	19%
High school education	29%	41%
Agricultural worker	71%	89%

Source: Liang, Zai, Yiu Por Chen, and Yasmin Gu. 2002. "Rural Industrialization an Internal Migration in China." URBAN STUDIES 39(12):2175–2187. Copyright © 2002, Urban Studies Journal Limited. Reprinted by Permission of SAGE. Table 2. P. 2182. "Descriptive characteristics of Chinese internal migrants versus non-migrants."

The few available studies of the assimilation and acculturation of Chinese rural migrants indicate that, although the pay is good, there is discrimination and resentment and that the jobs are often physically demanding (Goodkind & West, 2002). The migrants are frequently not provided with normal urban services, even including access to schools (Chan & Zhang, 2003; Goodkind & West, 2002). Disorganization, reduced commitment, lowered involvement in communities, and limited external control have led to high crime rates for the migrants (Lo & Jiang, 2006). In Beijing, Shanghai, and Guangzhou, estimates are that between 40 and 60 percent of crimes are committed by transient migrants. The "floaters" cannot find jobs, develop stress, perceive the inequality in the cities, and in some cases, transition to crime (Lo & Jiang, 2006).

Summary

This chapter has introduced migration, which constitutes one of the major growth and change factors for cities. After discussing the basic concepts and principles of migration and residential mobility, the chapter presented the background of the lab exercise on accessibility for a proposed environmental center in Los Angeles, using the population potential index. The U.S. and Australian populations were seen to be highly mobile. International immigration, on the rise today, is caused by a combination of push and pull factors. The overall trend is for movement from sending nations in the developing world toward the developed world. The case example of immigration from the Dominican Republic to the United States profiles

first-generation immigrants who were "pulled" by economic opportunity, only to be marginalized on arrival in some serious respects, while retaining a close bond with their homeland through a large diaspora. The final case concerns rural-to-urban migration within China, the *hukou* system, and marginalization of migrants. The resultant floating population is likely to become larger and more problematic unless the government can provide it with more resources and legitimacy.

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Exercise

Exercise Description

Evaluating the accessibility of four sites proposed for an environmental educational center to the non-English-speaking population of Los Angeles County.

Several local conservation groups have challenged the idea that environmental education is equally accessible to the population of Los Angeles County. One concern that has been raised by these groups is that a large share of the population of Los Angeles County is made up of recent immigrants who are underserved by environmental education centers where conservation concepts are communicated in English.

In this project, we assume the following hypothetical arrangement. As part of its marketing strategy, called Making Environmental Education Accessible with Smart Locations, Los Angeles County has appointed you to help evaluate the location of four proposed sites to house a new graphic-intensive environmental education center for the non-English-speaking population of Los Angeles County. The county has identified four available office buildings that would serve as excellent high-tech education centers, but only one can be selected as the center. The four candidate locations are in Torrance, Santa Monica, Pasadena, and Burbank. Los Angeles County wants you to consider the four sites and determine the one that is most accessible to the non-English-speaking population of the county.

Background Information

Population Potential: We employ a technique referred to as a population potential (Warntz, 1964), more generally known as an accessibility index (Plane & Rogerson, 1994):

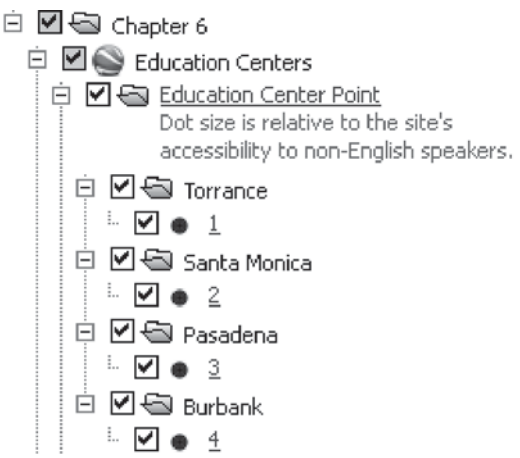
$$v_j = \sum_{i=1}^{r} (P_i/d_{ij})$$

where v_j, at any site j, is found by first taking the population, P_i, of every subarea i in the study area and dividing by the distance d_{ij} from its centroid to the site. Then these ratios are summed for all r subareas, $i = 1, 2, \ldots, r$.

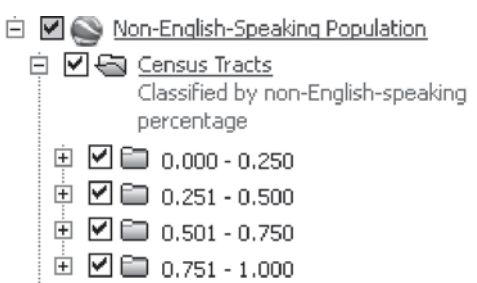
The larger the accessibility value for a location is, the more accessible that location will be to a population distribution.

Google Earth Version

1. Launch the Chapter 6 Google Earth KMZ file by double-clicking it: *EUC_Ex6.kmz*
2. Double-click Education Centers under Chapter 6 in the Table of Contents to zoom to the four sites.
3. Expand Education Centers. Under Layers, turn off Borders and Labels. Click each Education Center Point on and off to see the center locations.
4. Which circle is largest and why? Review the Chapter 6 section called "Analyzing an Urban Issue" for more background.



5. Turn Borders and Labels back on. Save a copy of the map as a jpg image to submit with your essay by clicking File, Save, and Save Image.
6. Expand Non-English-Speaking Population and Census Tracts. Turn off Information Points.



7. Individually click the plus sign in front of each range to see its associated color.
8. What percentage range of the non-English-speaking population does red represent on the map?

   Orange?
   Light green?
   Red?
   Green?

9. Use Street View to find evidence of the types of languages that are spoken in some of the largely non-English-speaking neighborhoods. Use the Fly To box, and enter the locations listed below. When you are viewing a location, temporarily uncheck Non-English-Speaking Population in order to better see the imagery. Then drag the Street View icon to a blue line near the address.

   E 4th St. and S Fresno Street, Los Angeles

   This is a Spanish language example.

   2904 James M. Wood Blvd, Los Angeles

   This is a Korean language example.

   952 N Hill Street, Los Angeles

   This is a Chinese language example.

10. Double-click the camera to move up and down the street. Once there, use the directional and scaling panel to examine the neighborhood. You can also click and hold on the screen to move around in any direction. Look around the neighborhood using cameras to study it further.
11. Study the streetscape for its relationship to language and culture. Also, consider how far the location is from the nearest education center and what the transport routes are in between. Save at least one of the above language streetscapes, and several that you find on your own, as a jpg images to include with your ArcGIS essay.

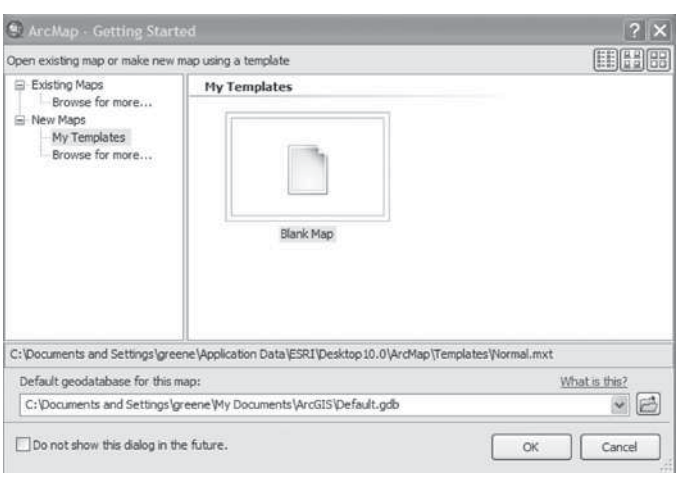
Google Earth Short Essay: Turn on Non-English-Speaking Population, and turn off Information Points. Under Primary Database, turn on Geographic Web, Roads, and 3D Buildings. You can also utilize Street View if it is helpful.

Assume that the government now can afford two more education centers. Recommend two more locations for the education centers, other than the ones already mentioned. Give either the street address or the cross streets. Justify your site choices based on the location of the non-English-speaking population in Los Angeles, the transportation network, and other information you gather on a particular location by viewing this 3-D map.

ArcGIS 10 Version

Part 1: Set up the map and explore the GIS layers.

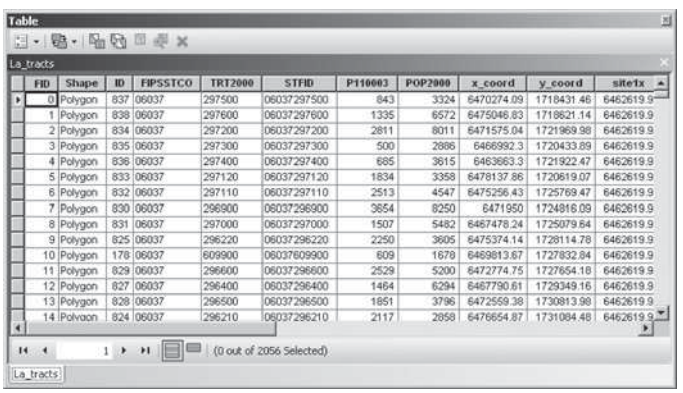
1. Start ArcMap. Under New Maps, click My Templates, and then double-click the Blank Map template.



2. Click Add Data, and navigate to the exercise data folder.

Note: If you do not see the folder where you placed the exercise data, you will need to make a new connection to the root directory that holds the data.

3. Add edsites.shp and La_tracts.shp from the Chapter 6 folder. (Do not add lacounty.shp; you will add that later.) You can add the two layers at once by clicking on one of the file names, clicking on the other one while holding down the Ctrl key on the keyboard, and then clicking Add.
4. Right-click edsites, and click Zoom To Layer. For drawing order, edsites should be on the top and La_tracts on the bottom. If it is not, you can click a layer name in the Table of Contents and drag the layer to a new position.
5. Open the attribute table for La_tracts by right-clicking its name and then clicking Open Attribute Table.



6. Note that the table includes the following fields:

   P110003: 2000 population for which the language spoken at home is other than English.
   POP2000: 2000 population.
   x_coord: The *x* coordinate for an internal point within a census tract.
   y_coord: The *y* coordinate for an internal point within a census tract.

7. Scroll over and note the next eight fields:

   Site1x: The *x* coordinate for the point representing the Torrance site (site 1),
   Site1y: The *y* coordinate for the point representing the Torrance site (site 1),
   and so on.

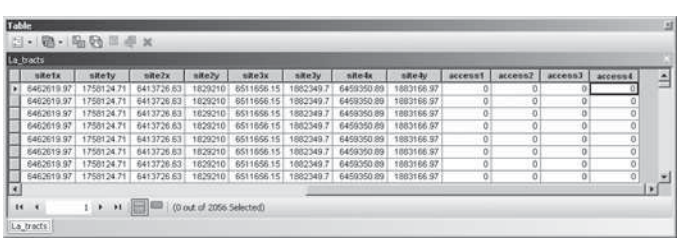


Table
La_tracts
site1x site1y site2x site2y site3x site3y site4x site4y access1 access2 access3 access4
6462619.97 1758124.71 6413726.63 1829210 6511656.15 1882349.7 6459350.89 1883166.97 0 0 0 0
(0 out of 2056 Selected)
La_tracts

Part 2: Calculating the Accessibility Index

The following formulas are used for calculating the accessibility index for each site:

$$A_1 = (\text{noneng}_1/\text{dist}_1 \text{ to Site}_1) + (\text{noneng}_2/\text{dist}_2 \text{ to Site}_1) + \cdots + (\text{noneng}_{2056}/\text{dist}_{2056} \text{ to Site}_1)$$

$$A_2 = (\text{noneng}_1/\text{dist}_1 \text{ to Site}_2) + (\text{noneng}_2/\text{dist}_2 \text{ to Site}_2) + \cdots + (\text{noneng}_{2056}/\text{dist}_{2056} \text{ to Site}_2)$$

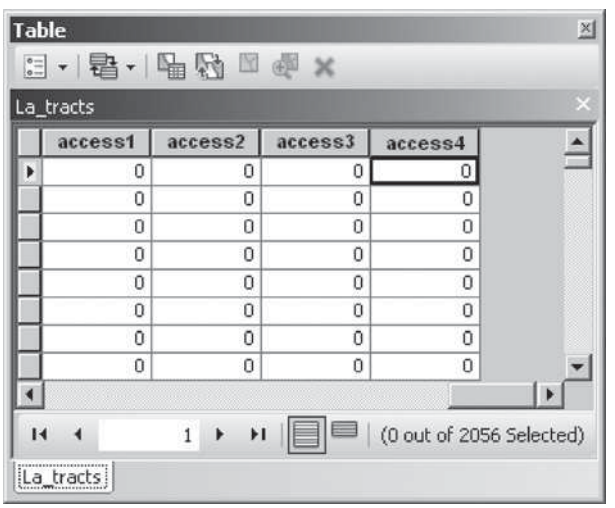
$$A_3 = (\text{noneng}_1/\text{dist}_1 \text{ to Site}_3) + (\text{noneng}_2/\text{dist}_2 \text{ to Site}_3) + \cdots + (\text{noneng}_{2056}/\text{dist}_{2056} \text{ to Site}_3)$$

$$A_4 = (\text{noneng}_1/\text{dist}_1 \text{ to Site}_4) + (\text{noneng}_2/\text{dist}_2 \text{ to Site}_4) + \cdots + (\text{noneng}_{2056}/\text{dist}_{2056} \text{ to Site}_4)$$

where A_1 is the accessibility index for the first education site, noneng_1 is the non-English-speaking population for Census Tract 1, and dist_1 is the distance between the non-English-speaking population of Census Tract 1 and the location of the first education site; noneng_2 refers to Census Tract 2, and so on; noneng_{2056} refers to Census Tract 2056 (there is a total of 2,056 census tracts in Los Angeles County). Similar calculations are used for the remaining three education sites.

8. Scroll over and note the final four fields of the table:

   access1: Field to compute accessibility for the site at Torrance
   access2: Field to compute accessibility for the site at Santa Monica
   access3: Field to compute accessibility for the site at Pasadena
   access4: Field to compute accessibility for the site at Burbank



9. To calculate access1, for Torrance, right-click the field name, and click Field Calculator.
10. Click Load, and open the site1 formula. Click OK.

    The site1 formula is a script for the term P_i/d_{ij} for site 1 in Torrance. This way you do not have to type the four formulas. Take a look at one of the formulas to gain an understanding of it. Note that the distance is being divided by 5,280, which is a conversion factor for feet to miles.
11. Repeat Steps 9 and 10 for access2, access3, and access4, loading their respective formulas (site2, site3, and site4).
12. To calculate the accessibility of each site, right-click the field names (access1–4), and click Statistics.

    Record the sum for each:

Site 1	Torrance	357,902
Site 2	Santa Monica	339,914
Site 3	Pasadena	416,231
Site 4	Burbank	447,272

    Clearly, the proposed Burbank Education Center is the most accessible to the population that speaks a language other than English at home. Close the table.
13. Add a field to edsites called Access, and calculate it to equal the above values.

    13.1. Right-click edsites, and select Open Attribute Table.
    13.2. Click Table Options, and then click Add Field.
    13.3. For name type, select Access.
    13.4. For type, select Long Integer.
    13.5. For precision, select 8.
14. Leave the table open, right-click on the gray menu bar at the top of the screen, and turn on the Editor toolbar. Alternatively, you can select Toolbars from the View menu.

14.1. Click the Editor dropdown menu on the Editor toolbar, and click Start Editing.
14.2. Click the topmost cell in the field column for Access. This corresponds to site 1, Torrance. Type in the value 357902.
14.3. Repeat this process to enter the remaining values for Access.
14.4. Click the Editor tab on the Editor toolbar, and then click Stop Editing. Answer Yes to Save Edits.
14.5. Close the table.

15. Right-click the edsites layer name, and select Properties. Click the Symbology tab of the Layer Properties dialog box. Next click Quantities, and then click Graduated Symbols. Click the Fields Value dropdown list, and select Access. Click Apply, and then click OK. Your map should look like the following:

16. Select Layout View from the View menu to compose a map for printing.
17. Click Insert, and then click Legend.
18. In the Legend Wizard dialog box, make sure that the only legend item is Edsites. For instance, select La_tracts in the right column, and use the single arrow symbol to move it to the left column.
19. Click Next, erase the word "Legend" by backspacing, and replace it with "Access Value."
20. Click Next on the next several dialog boxes, and then click Finish.
21. Now double-click the selected legend. Click the Items tab, and in the right-hand column, double-click Edsites. Choose the Horizontal Single Symbol Label Only legend style. Click OK, and close the Legend Properties window. Reposition the legend to a suitable place.
22. Click Insert at the top, and insert a title for your map. Reposition the title if necessary.
23. To create the same map as just shown, you could make the LA_tract symbol hollow with a gray outline and add the lacounty layer, also making it hollow with a county outline symbol.

ArcGIS 10 Short Essay: In your essay, review the chapter section and the readings on population potentials, and discuss the strengths and weaknesses of this method for evaluating the four potential government-sponsored environmental education sites in Los Angeles County. Suggest ways to enhance the method. An example of something to consider is whether the method recognizes transportation and, if not, how transport can be reckoned with. Include observations of the language and culture of nearby neighborhoods from the Google Earth exercise.

Log in to www.mygeoscienceplace.com for ArcGIS Exercise data files, Google Earth™ Exercise kmz files, RSS feeds, flashcards, web links, and self-study quizzes to enhance your study of migration and residential mobility.

CHAPTER

7 Race, Ethnicity, Gender, and Poverty

This chapter concerns the geography of race, ethnicity, gender, and poverty. These fundamental aspects of cities go back millennia. For instance, Roman cities had racial and ethnic groups, and some residents lived in poverty. The chapter focuses on these topics in the context of the United States; there is also some discussion of the issues in China, Mexico, Central America, and Europe. The chapter considers the geographic background of ethnic enclaves and identity, followed by a section on the concepts, processes, and measurement of race, ethnicity, and segregation. It discusses the U.S. experiences with immigration, ethnic distribution, and segregation. A growing knowledge about gender in cities is examined, including studies leading to better understanding of gender and sexuality in the city and the feminist approaches to urban geography and geographic information systems (GIS). Gender differences lead to varied perceptions, experiences, and priorities in cities. One section defines poverty and explains how to measure it. Then poverty is considered for the United States and its cities, including poverty in the ghetto. The last section considers a different type of poverty—that of the *colonias,* the largely unplanned communities on the peripheries of U.S. border cities.

Race refers to a large portion of humanity unified by common physical and genetic traits. Often race involves some type of common history or culture. Examples of races are Black, White, and Asian. *Ethnicity* refers to smaller groups of people classified according to common cultural, national, tribal, religious, or linguistic background. Both race and ethnicity are culturally and socially determined phenomena, although race is more likely to involve common physical characteristics. Examples of ethnic categories are Russian, Cuban, and Hispanic. Jews are an example of an ethnic group determined by religion. Ethnic groups are not sharply divided, and often a person can belong to more than one ethnic group. For instance, a person can be both Argentinian and Hispanic or both Polish and Jewish. Hispanic and Latino have different meanings to some and the same meaning to others. We have chosen in this book to regard them as the same and use them interchangeably. The U.S. Census Bureau has standardized mostly on Hispanic and does not distinguish Latino from Hispanic in its census attributes (U.S. Census Bureau, 2010a).

A person has both race and ethnicity; for instance, a White Scandinavian or a Black French person. These concepts are influential in the geography of cities for many reasons. For example, people of the same racial or ethnic backgrounds often group together in the same neighborhoods or areas, they have shared traditions and cultural backgrounds, and they sometimes act as a voting group in urban politics.

Ethnic or racial distributions in cities are not static, but change dynamically as new immigrants arrive and existing groups move to other neighborhoods or depart the city. The multiple ethnic identities of cities give them much of their interest and excitement, but at the same time can lead to tensions, conflict, separation, or segregation.

Intermarriage across ethnic or racial lines also influences racial and ethnic change. Some cities that historically had numerous distinctive ethnic neighborhoods today are more homogenous as a result of intermarriage. An example is a comparison of the racial and ethnic mix of the city of Chicago at the start of the 20th century versus the city today. In 1900, Chicago had many distinctive European immigrant communities—among them, Poles, Germans, Hungarians, Italians, and Irish. Today, the city still has substantial ethnic groups, but the composition of ethnicities has changed, with a larger proportion of Hispanic ethnic groups and Blacks and with some assimilation of earlier European immigrant populations, so

FIGURE 7.1 Italian-American neighborhood in Chicago.

they identify more as Americans than as Poles or other groups. An Italian-American neighborhood in Chicago is seen in Figure 7.1.

The second section of the chapter focuses on poverty, mostly in the United States, but also in China, Europe, and Mexico. *Poverty* refers to the situation in which individuals, households, or families have below-average living conditions, including access to food, clothing, shelter, and money. It is usually measured in terms of monetary value—often that of a minimum basket of basic items for living. There is no single, worldwide standard for measuring poverty. Rather, many nations have established their own definitions. Those affected by it cannot gain access to amenities that tend to make life more comfortable, not to mention luxuries that many of us can enjoy from time to time. At the same time, people in poverty often work productively. In fact, people in poverty exhibit quite a bit of diversity and specifically do not fit a widespread image of unproductive and antisocial behavior (Jargowsky, 1996). For instance, many students are poor while attending college, and some even would be placed under the official poverty line. In the United States and other countries, certain racial and ethnic groups are overrepresented in poverty. For instance, Blacks in the United States and indigenous peoples in Mexico are more likely than average to be impoverished. This chapter examines the history of how poverty became associated with certain ethnic groups.

7.1 ETHNIC ENCLAVES AND COMMUNITY IDENTITIES

Many cities are known for their ethnic districts, neighborhoods, and sections. Who would think of Boston without its Italian and Irish neighborhoods and Miami without its Cuban sections? Not only do people of the same ethnic identity in a city often tend to reside in the same neighborhoods, but also their ethnicity is manifest in the shopping, public events, social life, festivities, restaurants, art, and even music of the area. Figure 7.2 shows a quiet morning street scene in such a neighborhood, Greek Town in Chicago. Geographers, sociologists, and urban historians have long been studying ethnic identity and its relationship to city geography and spatial processes. The range of ethnic and racial identities contributes to the larger concept of "urbanism as a way of life" (Wirth, 1938). This concept refers to the total atmosphere of living in the complexities of a city, of which ethnic differences are a part. Along with other factors, ethnicity fosters in cities a particular urban feeling—that is, urbanism—that distinguishes them from rural areas (Frey & Zimmer, 2001).

In New York City, the Russian community of "Little Odessa" is centered in Brighton Beach in southern Brooklyn, where Lower New York Bay enters the Atlantic Ocean (see Figure 7.3 on page 207). There are other, smaller Russian immigrant zones in central Brooklyn and in the Washington Heights area of upper Manhattan. The Russian community in New York City has developed from the stream of Russian immigrants arriving in the United States since the 1970s. About a quarter of all Russians arriving in the United States settled in New York City, and 70 percent of those settled in Brighton Beach (Miyares, 1998). Brighton Beach, in the 1860s a beach resort, later changed to an entertainment area and in the 1960s became primarily residential with local businesses (Miyares, 1998). The Russians have transformed it further. They have purchased most of the businesses, and Russian language and signs are commonplace. Russian immigrants in Brighton Beach are seen in Figure 7.4 (see page 207). Many of the immigrants were highly educated, including professionals, and as a result, the process of assimilation has involved less social-service aid than with other immigrant groups (Miyares, 1998). Many of the Russian immigrants have shifted their professional training and management experience from the Soviet Union into entrepreneurial small businesses, which have done well, including retail outlets, professional offices, restaurants, and insurance firms. There is an entrepreneurial spirit, which some have even called a "hustling mentality" (Gold, 1988). The success of Little Odessa and its immigrants has been notable and has contributed to the contemporary economy and ethnic mix of New York.

The Chinese community in Los Angeles represents a longer-established ethnic and immigrant group. In 2006–2008, there were 376,000 ethnic Chinese in Los Angeles County, as well as 115,000 in the surrounding metropolitan counties of Orange, Riverside, San Bernardino, and Ventura (U.S. Census Bureau, 2010a). Chinese had first arrived in the 19th century, and the original Chinatown had moved around to several locations near downtown Los Angeles (Allen & Turner, 2002). Today, as seen in

FIGURE 7.2 Greek Town in Chicago. *Source*: James Pick.

Figure 7.5 (see page 208), a large concentration of Chinese live in the western San Gabriel Valley, extending from Monterey Park northward (Lin & Robinson, 2005). This area has tended to attract affluent Chinese immigrants. It serves as the Chinese financial and business center in southern California and some would say in the nation (Zhou, 1998). A second large concentration is located to the southwest of the first one in Hacienda Heights, Rowland Heights, and Walnut. It has extensive Chinese businesses, commerce, and residences (Lin & Robinson, 2005). In the Los Angeles area, Chinese have also settled in Cerritos, on the Palos Verdes Peninsula, in the northern San Fernando Valley, and in small clusters around the major universities—University of California at Los Angeles, University of Southern California, Cal State Fullerton, and University of California at Irvine.

In recent decades, the Chinese immigrants to the Los Angeles metro area have tended to be well-educated professionals, and usually middle class or wealthy. They are often from Taiwan or Hong Kong (Zhou, 1998). Many Chinese have advanced well in small- to large-sized businesses. Chinese in recent decades have been important in high-tech industries and in transnational business with Asia (Li, 2007). Chinese immigrants to New York City have tended somewhat more to be working class and more likely to have come from mainland China. Los Angeles's attraction to the prosperous group of Chinese is better financial support to certain of the migrants, as well as economic ties, because there is a network of connections and transnational business links between the ethnic Chinese economy of greater Los Angeles and the dynamic economy of China (Li, 2007; Zhou, 1998). Many Chinese immigrant families have excelled educationally, and at the top there have been four Chinese-American Nobel Prize winners (Li, 2007), including Steven Chu, the Secretary of Energy in the Obama administration. In greater Los Angeles, this large and successful ethnic group has demonstrated that the factors for economic success are present for an arriving ethnic group if the circumstances are right. Many other cities in the United States have had significant Chinese immigration and domestic in-migration, leading to the development of communities in Seattle (Figure 7.6 on page 208), San Diego, Atlanta, Houston, and Dallas (Li, 2007).

The original ethnic identities have been preserved in many ethnic neighborhoods and zones of cities. Often the use of the native language by immigrants has been reduced greatly after the first generation (Portes & Rumbaut, 2001), but many aspects of culture have been maintained over several generations.

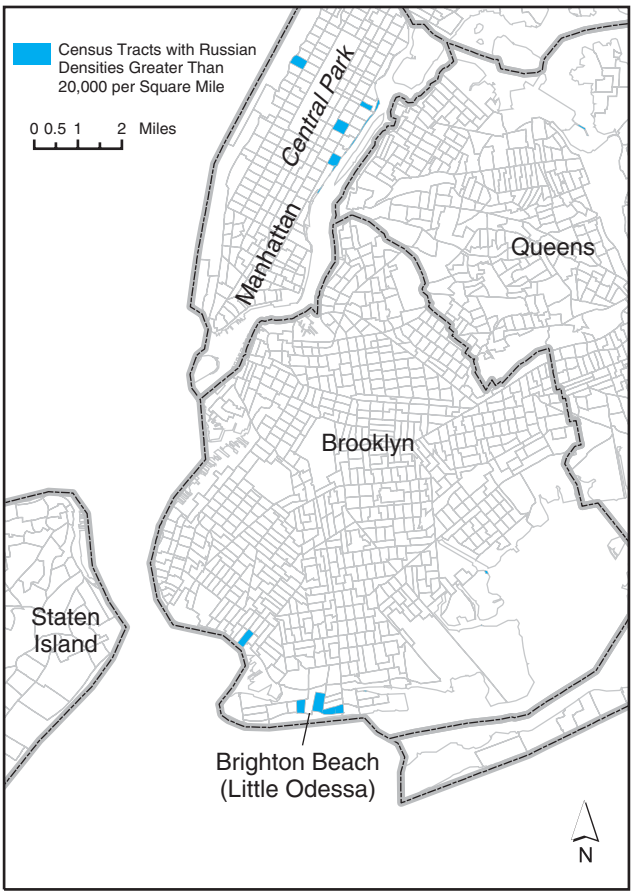


FIGURE 7.3 Russian communities in New York City.

In other nations, cities have received foreign and domestic ethnic groups that have settled into distinct parts of cities and influenced their identity and culture. The city of Montreal started out French and is heavily influenced by the French heritage of the majority of its citizens. Mexico City has communities such as Milpa Alta and Chalco in the southeast and Huixquilucan in the west with high concentrations of indigenous people, from a mixture of specific Indian groups (Pick & Butler, 2000).

7.2 CONCEPTS AND PROCESSES OF RACE, ETHNICITY, AND SEGREGATION

Race, ethnicity, and segregation are measured and analyzed through simple ratios, as well as through more complex techniques. This section introduces you to the measurement of these phenomena. The techniques include simple percentages, the charting of ethnic and racial distributions, the index of dissimilarity for segregation, and the centrographic method of measuring spatial location and extent. The centrographic method is utilized later in the chapter's GIS exercise to evaluate the degree to which Blacks are more or less segregated than Hispanics in Dallas.

To measure a single racial or ethnic category, the *percentage of a group in a base population* is a common measure. For instance, the percentage of Asians among all persons in Los Angeles is calculated as follows:

$$\text{Percentage Asian} = 100 \times \frac{\text{Total number of Asians}}{\text{Total population}}$$

FIGURE 7.4 Immigrants in Little Odessa in Brighton Beach, New York. *Source*: Getty Images, Inc.–Liaison.

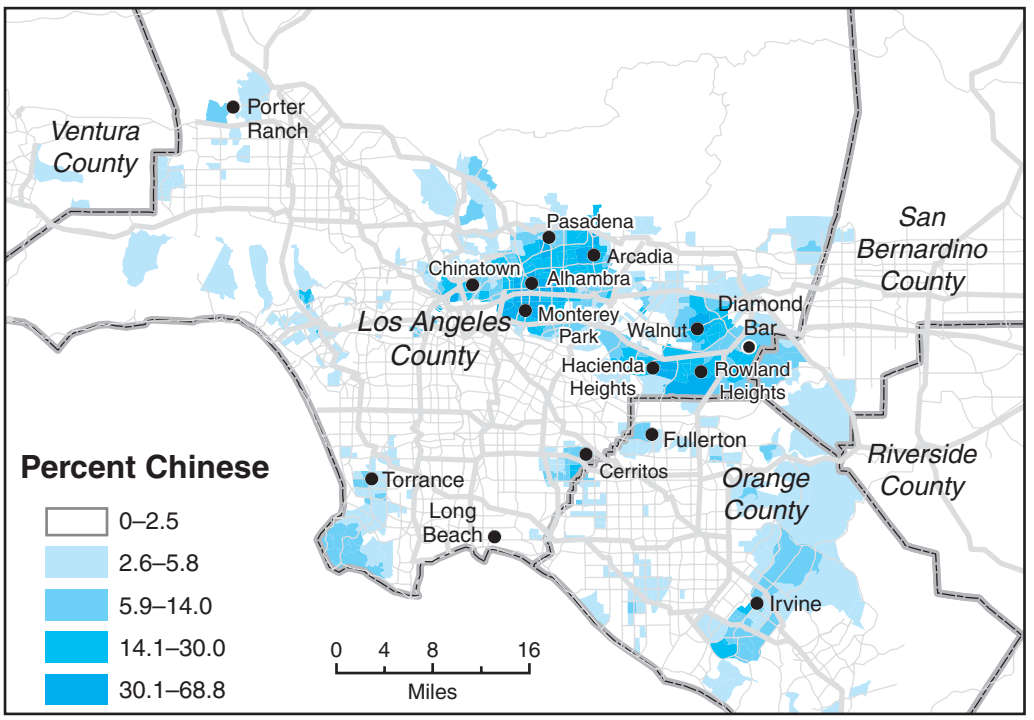


FIGURE 7.5 Percentage of Chinese in the Los Angeles urban area, 2000. *Source*: U.S. Census Bureau, *U.S. Census of 2000*, Washington, DC: Author, 2003.

FIGURE 7.6 Seattle's Chinatown.

An example is the city of Chicago, which in 2006–2008 had 134,736 Asians out of a total population of 2,725,206. The data, drawn from the American Community Survey of the U.S. Census Bureau, are averaged for the years 2006–2008 (U.S. Census Bureau, 2010a). The data are averaged in order to gain accuracy from sampling over three years. This example uses the concept of city, not the combined statistical area (CSA) discussed in Chapter 2. Percentage Asian is computed as follows:

$$100 \times (134{,}736/2{,}725{,}206) = 4.9 \text{ percent Asian}$$

The same approach can be used to calculate Chicago's percentage of Spanish or Latino in 2006–2008:

$$\text{Percentage Spanish or Latino of any race} = 100 \times \frac{\text{Total number of Spanish or Latino}}{\text{Total population}}$$

$$100 \times (758{,}877/2{,}725{,}206) = 27.8 \text{ percent}$$

Since the U.S. average percentage of Hispanics or Latinos is 14.7, we can further calculate the ratio of Chicago's percentage to the national average percentage as follows:

$$= 28.1/14.7 = 1.91$$

The city of Chicago in 2006–2008 had nearly double the percentage of Hispanics/Latinos as the nation.

The relative size distributions of different ethnic groups can be shown by simple *proportionate distribution*. For instance, in the New York–Northern New Jersey–Long Island consolidated metropolitan statistical area (CMSA) in 2000, out of 21,104,292

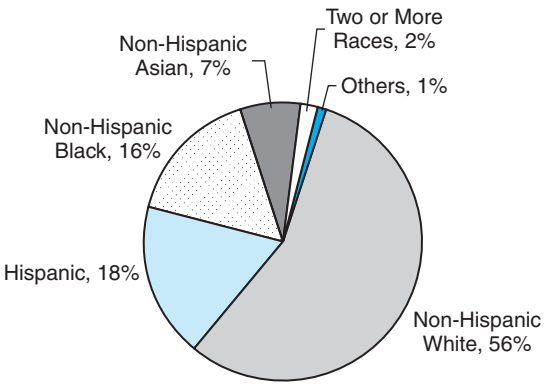


FIGURE 7.7 Racial distribution in the New York–New Jersey–Long Island consolidated metropolitan region, 2000. *Source*: U.S. Census Bureau, U.S. Census of 2000, Washington, DC: Author, 2003.

total residents, there were 11,863,430 non-Hispanic Whites, 3,849,990 Hispanics, 3,406,201 non-Hispanic Blacks, 1,423,211 non-Hispanic Asians, 429,324 of two or more races other than Hispanics or Blacks, and 132,136 other races (U.S. Census Bureau, 2002). The non-Hispanic categories are present because any census respondent can declare himself or herself as Hispanic or not. Using the non-Hispanic categories means that a respondent will not be counted twice. The distribution can be pictured in a pie chart in percentages (see Figure 7.7).

Racial segregation represents substantial overconcentration of a particular racial group, relative to another racial group, in particular zones of a city and with corresponding substantial underconcentration in other zones. Just where the cutoff becomes substantial is up to the researcher or analyst to decide. This measure is a statistical one based on numbers of people. It does not measure psychosocial aspects of segregation or the intent by parties to create or maintain segregation. An example of the data used to estimate segregation is the simplified data set on the percentage of Blacks versus the percentage of Whites shown in Table 7.1.

Racial segregation can be calculated by the *index of dissimilarity*, which has the formula

$$\text{Index of dissimilarity} = 0.5 \sum |m_i - n_i|$$

where m_i is the ratio of the number of minority persons in the ith geographic zone to all minority persons and n_i is the ratio of the number of nonminority persons in the ith geographic zone to all nonminority persons.

On the basis of the table, we calculate

$$\begin{aligned}\text{Index of dissimilarity} &= 0.5 \times (|0.8 - 0.2| + |0.1 - 0.4| \\ &\quad + |0.05 - 0.25| + |0.05 - 0.15|) \\ &= 0.6\end{aligned}$$

When you formulate this, the most important decisions are which group to select as the minority group and which comparison category to select as the nonminority group. Values for the index of dissimilarity range from 1 (maximum dissimilarity) to 0 (maximum similarity). Values for the index are given later in the chapter for racial segregation in the largest U.S. metropolitan areas.

The index of dissimilarity is useful in measuring segregation within a single community, but it does not summarize segregation for a spatial group of communities. We are sometimes interested in asking how spatially concentrated or dispersed racial or poverty attributes are across an area. This topic of spatial segregation is covered in the next section, "Analyzing an Urban Issue," which corresponds to the GIS exercise at the end of the chapter.

7.3 ANALYZING AN URBAN ISSUE: MEASURING SEGREGATION IN DALLAS–FORT WORTH

The *centrographic method* overcomes the problem that the index of dissimilarity does not measure the spatial distribution of population. It measures segregation by taking into account the reference community, as well as the surrounding area, and determining the extent of concentration or dispersal around a core point. This method can answer questions about which racial groups in a city are more or less dispersed.

The *mean center* locates the central core for the racial, ethnic, or poverty attribute. It is specified by an *x,y* point location. The *standard radius* measures the amount of dispersion of the attribute across the area. This dispersion is most commonly one standard deviation (Wong, 2003). To apply the method, we need to calculate the weighted mean center and the standard radius. The standard radius is the mean distance from the center for one standard deviation, or for about two-thirds of the population. The radius forms a circle around the mean center that shows how concentrated or dispersed a characteristic is spatially. The weights are proportional to the concentrations of the attributes at particular *x,y* coordinate locations (Wong, 2003).

For example, Japanese households in a U.S. city might have a mean center located 12 miles north and 4 miles west of the

TABLE 7.1 Example: Segregation Data and Calculations

Zone of Example City	Number of Blacks	Total Number of Whites	Population in the Zone	Proportion of Blacks	Proportion of Whites
A	80	20	100	0.8	0.2
B	10	40	100	0.1	0.4
C	5	25	100	0.05	0.25
D	5	15	100	0.05	0.15

central business district (CBD); this is the *x,y* point location. The weights represent the average number of individuals per household for the small areas being measured. The standard radius is calculated to be 5 miles. This means that about two-thirds of the Japanese individuals are located within 5 miles of the mean center. A large standard radius shows wide dispersion, whereas a small standard radius implies concentration in one portion of the area.

The formulas for the x and y coordinates of the weighted mean center are

$$x_w = \frac{\sum xw}{\sum w},\ y_w = \frac{\sum yw}{\sum w}$$

where x and y are geographic coordinates; w is the concentration weight for a particular racial, ethnic, or poverty attribute; and x_w and y_w are the *x,y* coordinates for the weighted mean center.

The formula for standard radius is as follows:

$$r = \sqrt{\left(\frac{\sum x^2}{n} - x_w^2\right) + \left(\frac{\sum y^2}{n} - y_w^2\right)}$$

where x and y are geographic coordinates and n is the total number of points.

If standard deviational circles are calculated for two ethnic groups, the sizes of the circles represent roughly how concentrated the groups are. If the circle for the first group is larger than the circle for the second group, the first group is more dispersed throughout the area.

More advanced centrographic techniques compute *standard deviational ellipses* instead of standard deviational circles (Gong, 2002; Wong, 2004). To do this, for each ellipse the method provides calculations of the weighted mean center, the directional orientation of the ellipse, and the dispersions for the long and short axes of the ellipse. As with circles, the extent of integration or segregation can be approximated by the sizes of the two or more ellipses, each representing an ethnic, racial, or poverty group. In addition, the ellipse offers the added value of indicating the spatial direction of greatest dispersion.

The exercises at the end of this chapter provide practice with the centrographic method. Specifically, you will compute the mean center and standard deviational ellipse for Blacks, Asians, and Hispanics in the Dallas–Fort Worth combined metropolitan area for 2000. The results using ellipses for Dallas–Fort Worth are shown in Figure 7.8. As part of the exercise, you will discuss the relative sizes of the circles and the amount of nonoverlap or overlap of the two groups.

For all these methods, it is important to consider the scale of the phenomenon in relation to what is being measured—that is, the size of the unit of observation. For instance, segregation can be measured by the index of dissimilarity for a city based on its census tracts or for a ZIP code based on its block groups. Each is measuring a somewhat different social phenomenon. The more microlevel segregation of block groups might have different causations than the segregation of ZIP code areas. In sum, a variety of centrographic techniques can be utilized to measure ethnic, racial, and poverty levels and distributions.

7.4 CITIES, IMMIGRANTS, AND ETHNICITIES

Many growing cities are built up partly through immigration over time, whereas others grow through natural increase. Periods of high immigration can occur at different time points. For instance, southern European immigrants arrived in New York City in large numbers at the turn of the 20th century; German cities in the 1970s and 1980s received large numbers of Turkish immigrants; Israel's cities received Russian immigrants in the 1980s; and U.S. port-of-entry cities such as Los Angeles, Houston, Chicago, and Washington, DC, received large volumes of Hispanic and Latino immigrants from the 1980s through the early 21st century.

As seen earlier, migrants arriving in cities bring along cultural, language, occupational, artistic, and business traits, skills, and experiences that impact the way of life of the city. At the same time, immigrants tend to become more assimilated and acculturated over generations. For instance, it is well known that most immigrant children arriving in U.S. cities will rapidly learn English and adapt to American customs and culture, while retaining some native cultural customs, whereas their grandparents will often continue to depend on their native languages and to maintain customs from their homelands (Portes & Rumbaut, 2001). Different immigrant groups vary in their speeds of adaptation.

Many scholars have studied the extent and speed with which the "melting pot" in the United States absorbs different ethnic groups (Glazer & Moynihan, 1970; Jacoby, 2004; McKee, 2000a). They do not agree on the extent or rapidity of assimilation and acculturation, or even on whether the melting pot is a plus or a minus (Jacoby, 2004). However, they largely agree that assimilation depends on the time of arrival, the institutions and processes present for assimilation, support from the native population, closeness or distance of the original country, culture, language, and other factors (McKee, 2000b). In the United States, for instance, the presence of a widespread public school system that stresses native language and culture has been a consistent stimulus to assimilation and acculturation (Portes & Rumbaut, 2001). On the other hand, resentment against arriving immigrant groups by dominant groups has sometimes slowed the process (Jacoby, 2004; McKee, 2000a). Examples in the United States include resentment of Chinese arriving in the late 19th century and resentment of immigrant groups sometimes associated with wartime enemies, such as Japanese Americans during World War II. The geographic aspect of this process is examined later in the chapter. This has been true more recently with the new Hispanic and Asian immigrants of the 1990s, who often arrived in Los Angeles and large Texas cities, but now are dispersing to medium-sized cities stretching from the Pacific Northwest to the Mid-South (Frey, 2002a; Pew Hispanic Center, 2010). In 2000–2008, counties showing rapid growth (over 45 percent) in their Hispanic population encompassed substantial territory in the Pacific Northwest, Nevada, western Arizona, northern and northeastern Texas, Florida, South Carolina, northern Illinois, southeastern Wisconsin, and most of the coastal parts of the northeastern states (Pew Hispanic Center, 2010). Thai immigrants have settled in Seattle, as seen from the Thai restaurant shown in Figure 7.9.

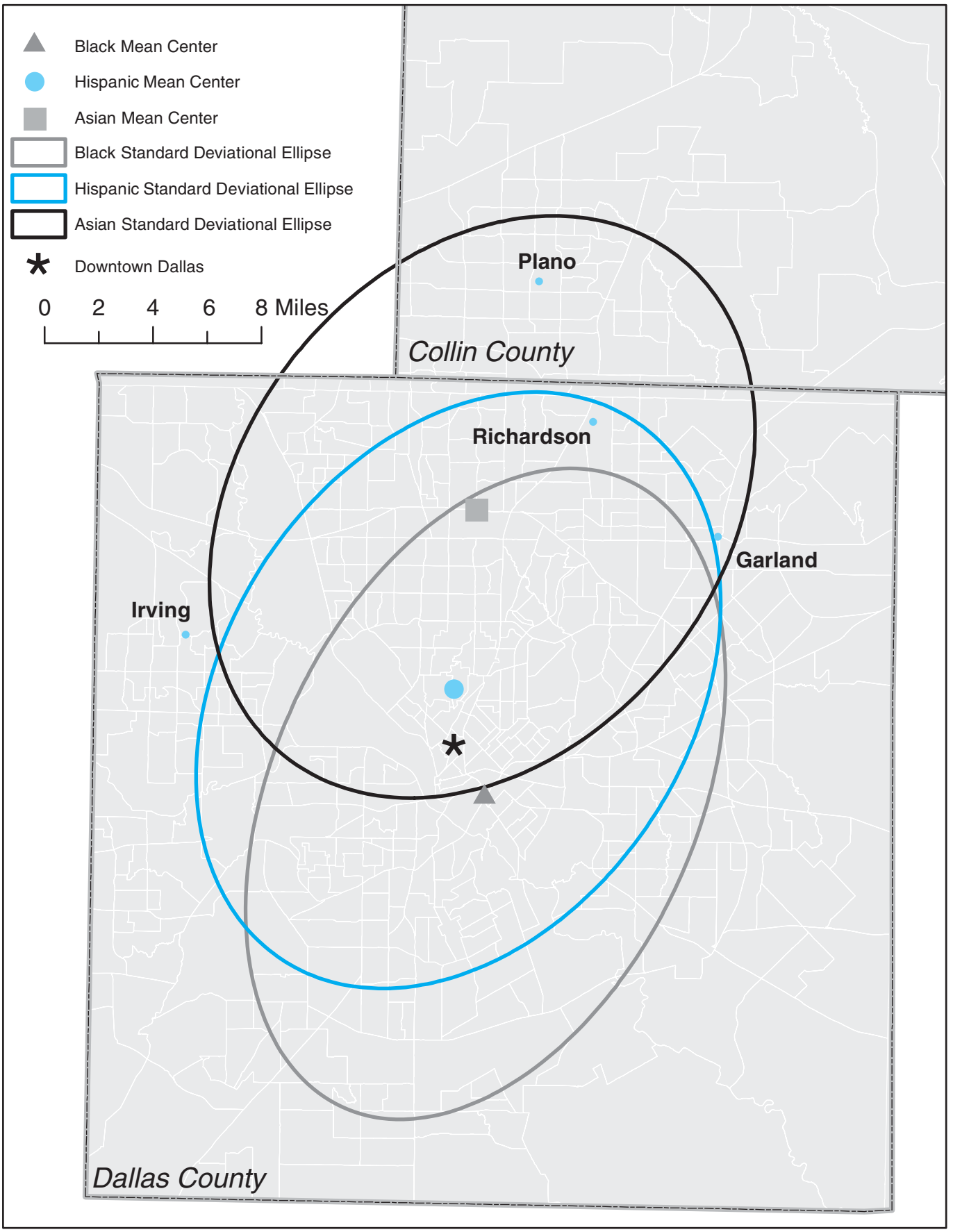


FIGURE 7.8 Centrographic results for ethnic groups in Dallas–Fort Worth.

FIGURE 7.9 Thai restaurant in Seattle.

There is also progressive movement of immigrant groups and their descendents over time within metropolitan areas. The example of residential mobility in Chicago was looked at in Chapter 6.

7.5 ETHNIC IMPACTS OF WAVES OF IMMIGRATION TO THE UNITED STATES

In a broad perspective, nations and their cities are built up and changed through waves of immigration—that is, surges from a particular origin. In the past century in the United States, a wave of southern and eastern European immigrants arrived, particularly in the first decade of the 20th century. This immigration surge began as the result of wars and economic privation in Europe in the first half of the 19th century, combined with the draw of a relatively prosperous and peaceful United States. As seen in Figure 7.10, in 1900, out of the U.S. population of 76 million, 10.3 million were foreign born, or nearly 14 percent. Most of the immigrants settled in cities, especially in large cities such as New York, Philadelphia, Boston, and Chicago (U.S. Census Bureau, 2001). After 1900, the foreign-born proportion grew somewhat to 14.7 percent in 1910, and then declined steadily to only 4.7 percent in 1970, as the earlier wave of immigrants died off. The reasons for this 60-year slide are varied. The U.S. experience with World War I led the nation to become more isolationist in the late 1920s and 1930s. During World War II, restrictions remained tight, although there were some refugees admitted, and the war itself cut off many traditional sources of immigrants. The 1950s through the 1970s were the decades of the Cold War and relatively restrictive immigration policies, although millions of immigrants continued to arrive (U.S. Census Bureau, 2001).

Starting in the 1980s, immigration into the United States grew again. During the 1980s, the U.S. population as a whole became steadily older, opening up jobs for younger workers, many of which could be filled by young, unskilled immigrants. The reasons are several. First, since the 1980s, the U.S. population has aged, so demand for unskilled jobs has grown. Immigrants tend to be young and fill in this gap. Second, international trade and other forms of global economic exchange

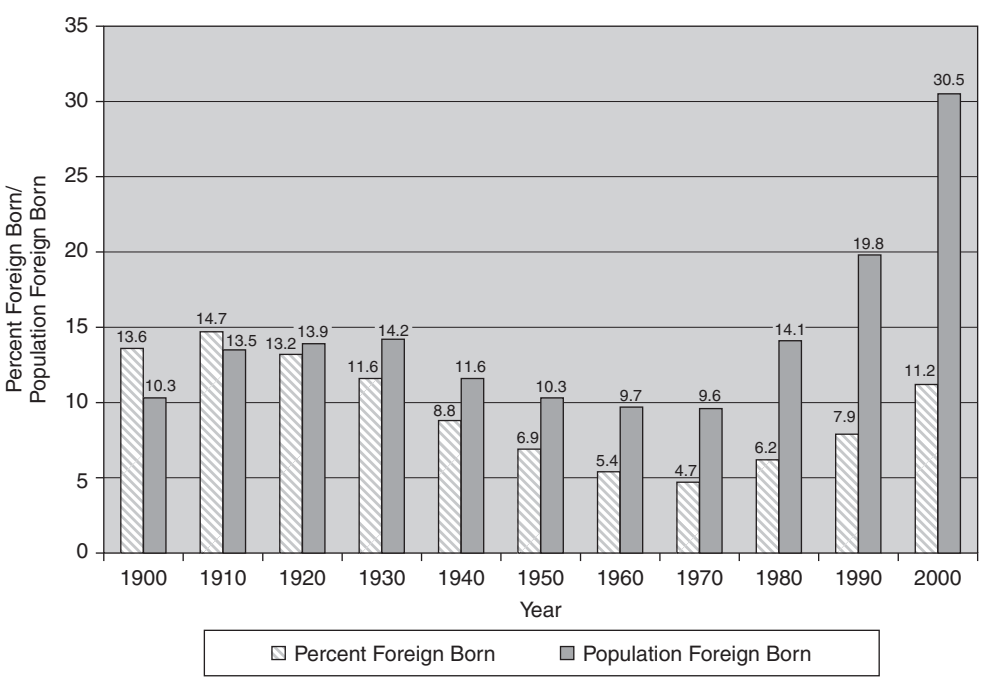


FIGURE 7.10 Foreign-born population, percentage and total, in the United States, 1900–2000.

expanded, and a global workforce developed. Third, wars, refugees, economic recessions, and privations in other nations created "push" factors to send immigrants into the United States. By 2006–2008, the foreign-born population in the United States had reached 12.5 percent, the highest level since 1930, reflecting an all-time record number of 37.7 million foreign-born residents (U.S. Census Bureau, 2010a).

As immigration numbers have fluctuated, so, too, have the origins of immigrants. As seen in Figure 7.11a, the wave of mid-19th-century immigrants to the United States came predominantly from northern and western Europe and from Canada. However, in the late 19th and early 20th centuries, the immigrant proportions shifted until half the immigrants were from southern and eastern Europe (Figure 7.11b). By the mid–20th century (1931–1960), the volume of immigration had greatly subsided, but the mix shifted again, to a greatly expanded proportion from Latin America, mostly from Mexico (Figure 7.11c). In the 1960s and 1970s, Latin American immigrants accounted for 39 percent of inflow and Asian immigrants 24 percent (Figure 7.11d). In the 1980s and 1990s, half of immigrants were from Latin

Figure 7.11a. U.S. Immigrants by Region of Origin, 1821–1880

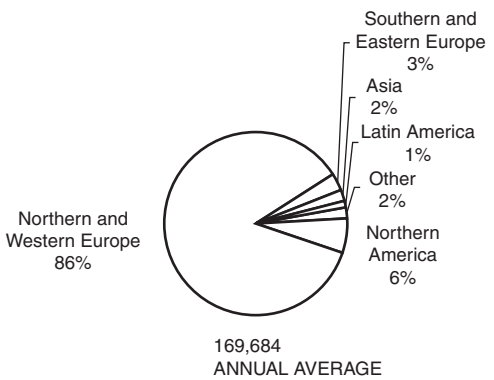


Figure 7.11b. U.S. Immigrants by Region of Origin, 1881–1930

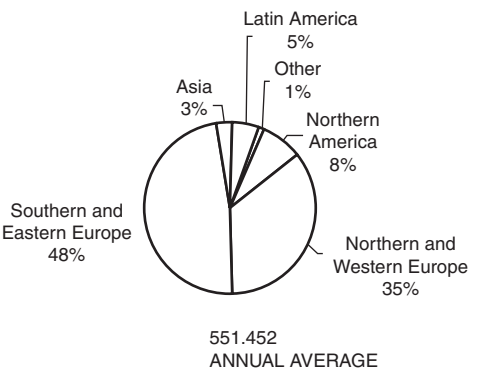


Figure 7.11c. U.S. Immigrants by Region of Origin, 1931–1960

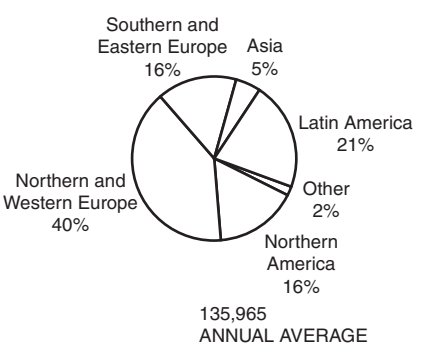


Figure 7.11d. U.S. Immigrants by Region of Origin, 1961–1979

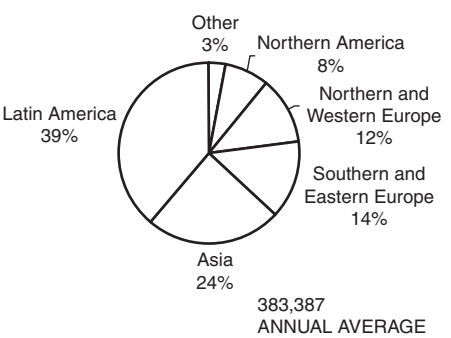
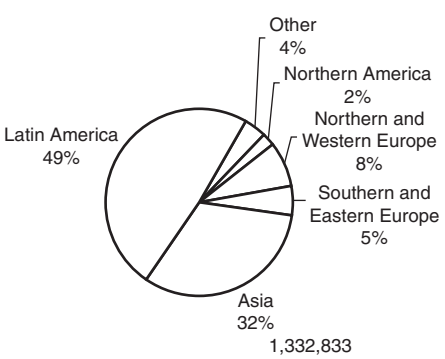


Figure 7.11e. U.S. Immigrants by Region of Origin, 1981–1999



Summary Table of Immigration to the U.S. by Region, 1821–1999

	1821–1880	1881–1930	1931–1960	1961–1979	1981–1999
Other	2%	1%	2%	3%	4%
Northern America	6%	8%	16%	8%	2%
Northern and Western Europe	86%	35%	40%	12%	8%
Southern and Eastern Europe	3%	48%	16%	14%	5%
Asia	2%	3%	5%	24%	32%
Latin America	1%	5%	21%	39%	49%
	100%	100%	100%	100%	100%
Average Annual Flow	169,684	135,965	551,452	383,387	1,332,833

FIGURE 7.11 U.S. immigration by region of origin, 1821–1999. *Source*: U.S. Immigration and Naturalization Service.

America, a third from Asia, and only 13 percent from Europe, as seen in Figure 7.11e. This late-20th-century flow was primarily economically driven.

This progression of sending nations and regions has impacted American cities in varying ways over the 180 years shown. As the immigrant waves have come and been supplanted, the ethnic mix and geography of settlement patterns within particular cities and metropolitan areas have changed. Understanding for a given city the changing mixture of immigrants and the spatial context of their arrival, dispersion, and assimilation is part of the study of urban geography.

The geographic arrival patterns are different today from a century ago. In 2000, the metropolitan areas that experienced the largest influx of overseas immigrants were the Los Angeles CMSA, followed by the New York, San Francisco–Oakland–San Jose, Miami–Fort Lauderdale, and Chicago CMSAs (see Table 7.2). The first three account for 11 million of the nation's foreign born, or 37 percent. All five of these cities are known for ethnic diversity and multiple cultures. A century ago in 1910, eastern and midwestern cities accounted for a large share of the foreign-born population. At that time, most immigrants settled in New York, Chicago, Philadelphia, Boston, and the younger city of Cleveland, all of which were known for their ethnic and racial diversity. These were "older" and more traditional cities, except for Chicago and Cleveland. They attracted immigrants because of their prosperous economies and jobs, as well as the networks of foreigners of the same origin already present.

This is typified by contrasting Chicago and Los Angeles over the past 130 years in their levels of foreign-born residents (see Figure 7.12). For a century, between 1870 and 1970, Chicago attracted more immigrants, resulting in a higher foreign-born proportion than Los Angeles. Since then, Los Angeles has experienced immigration leading to twice the percentage of foreign-born residents. Because Chicago was much larger during most of this period (i.e., until after World War II), a much larger number of immigrants came through Chicago.

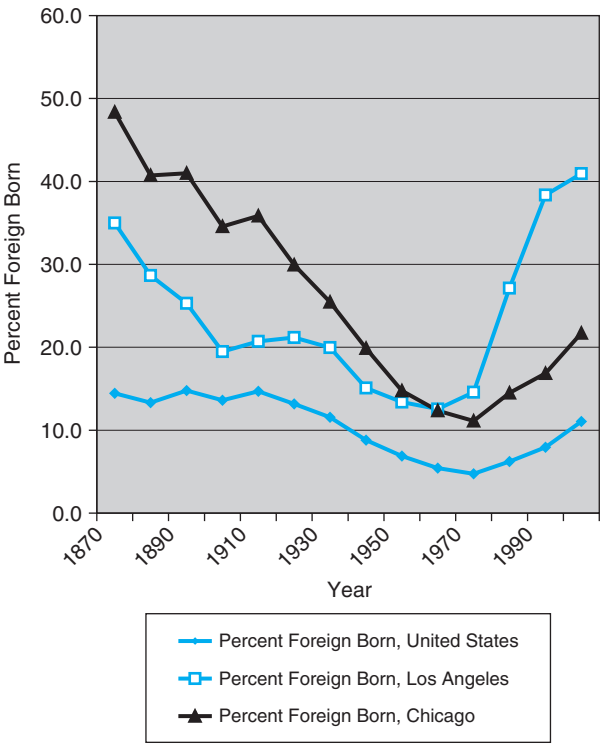


FIGURE 7.12 Percentage of foreign-born residents in Los Angeles, Chicago, and the United States, 1870–2000. *Source*: U.S. Bureau of the Census. Various Years. Decennial Censuses from 1870 to 2000. Washington, DC: Author.

TABLE 7.2 Metropolitan Areas with the Largest Foreign-Born Populations, 1910 and 2000

1910		2000	
City	Number of Foreign Born	Metropolitan Area	Number of Foreign Born
New York	1,927,703	Los Angeles–Riverside–Orange County CMSA	4,708,000
Chicago	781,217	New York–NJ–CT–PA CMSA	4,690,000
Philadelphia	382,578	San Francisco–Oakland–San Jose CMSA	2,007,000
Boston	240,722	Miami—Fort Lauderdale CMSA	1,647,000
Cleveland	195,703	Chicago–Gary–Kenosha CMSA	1,070,000

CMSA = consolidated metropolitan statistical area.

Sources: Spain, D. (1999). *America's Diversity: On the Edge of Two Centuries*. Washington, DC: Population Reference Bureau; U.S. Census Bureau. (2002). *Supplementary Survey Summary Tables: Profile of Selected Social Characteristics 2000* (AT-20). Washington, DC: Author.

Cities in other nations have also been influenced by waves of immigration. Buenos Aires and other large cities in Argentina received huge immigration inflows from Italy and southern Europe in the late 19th and early 20th centuries. The influence is seen today in many elements of Argentine culture, arts, customs, and architecture. Australia and its cities received substantial immigration from Asia in the late 20th and early 21st centuries. As seen in Chapter 6, waves of immigration are dynamic and influenced by push–pull and political factors that send immigrants from certain nations, attract them through economic opportunities, and regulate their flow through policies stemming from the countervailing political influences such as isolationism, globalization, national security, organized labor resistance, and workforce needs.

7.6 IMMIGRATION AND MIGRATION OF BLACKS AND HISPANICS TO THE UNITED STATES

The immigration and internal migration surges have affected all major ethnic groups in the United States and their geographic distribution in cities. This section gives particular attention to the U.S. history of geographic change for Blacks and Hispanics

or Latinos. We emphasize the influences of these immigration waves on U.S. cities.

7.6.1 Blacks

Blacks were first forcefully brought to the United States in 1619 as part of the slave trade. That trade continued over the next two centuries, and slaves resided mostly in the rural areas of the South, where their labor would be most useful to agriculture. After the abolition of slavery at the end of the Civil War, most Blacks remained in the South, but others began to migrate to the North (Wilson, 2007). Following the Civil War, there was housing segregation, which was reinforced by the policies of financial companies (Wilson, 2007). The "separate but equal" doctrine led to exclusion, so Blacks and Whites were separated in most public locations and "equal" really implied favoritism toward Whites (Wilson, 2007). In southern cities, Black tended to live nearby their White employers, whereas in northern cities, Blacks were sometimes accepted nearly as the equal of Whites (Massey & Denton, 1993).

In the late 19th century, Blacks started a long flow of migration from the rural South to the urban northern cities and later also to growing southern cities (Wilson, 2007). On arriving in the North, however, many migrants found that their dreams were not realized. One reason was the resistance of receiving cities to accepting larger proportions of Blacks. This resistance was also a factor leading to the start of the urban Black ghetto in the early 20th century. A *ghetto* is defined as a neighborhood or group of neighborhoods nearly entirely inhabited by a single racial or ethnic group and within which a large percentage of the city's members of that group live, especially due to social, legal, or economic pressure. It is important to emphasize that the urban Black ghetto was not present in the 19th century, a time when Blacks and Whites lived together in the North with a moderate amount of harmony (Massey & Denton, 1993). The major underlying cause of the increasing dominance of ghettos was the industrialization of the North, which required population to support new transformative industries. This implied the need for low-paid manufacturing workers, which offered opportunities to many arriving Blacks. It was convenient to build housing for these workers near the manufacturing plants, resulting in high concentrations of Blacks and, eventually, ghettos.

After World War I, the United States became increasingly isolationist, and partly as a result, the flow of European immigrants was sharply reduced (Massey & Denton, 1993). This opened up the opportunity to fill the gap through a much larger migration of southern Blacks to the North. Between 1910 and 1930, 1.4 million of them migrated to northern cities. The arrival of massive numbers of Blacks led to resistance from some Whites that added to the tendency to form ghettos, increased housing barriers for Blacks, and added to tensions that in certain cases boiled over into race riots (Massey & Denton, 1993). The color line became stronger and segregation increased. Segregation of Blacks in northern cities grew from an average index of dissimilarity of 46 in 1860 to 59 in 1910 to 89 in 1940 (Massey & Denton, 1993).

In the period from 1940 to 1970, tensions increased. Especially during the 1950s, there was White flight from the centers of northern cities to their suburbs. *White flight* represents movement of the White population from the central city to the suburbs, often due to the perceived need to get away from economic, educational, racial, and other types of problems and conflicts. Meanwhile, Black migration from the rural South continued, and most of the large Black ghettos continued to grow in size. Even though major urban riots involving mainly Black protest occurred between 1963 and 1968, the civil rights movement of the 1960s did bring about legal and regulatory improvements. Some discriminatory practices such as redlining were abolished. *Redlining* refers to financial institutions' withholding of home loans or insurance from residents in neighborhoods regarded as poor financial risks, often for cost-related reasons.

The Fair Housing Act of 1968 made discrimination in the sale or rental of housing illegal. From the 1960s to today, some improvements have taken place as the suburbs have opened up more to middle-class Blacks, especially in certain suburban sectors. Some additional discriminatory real estate practices have been curtailed. However, urban ghettos have persisted as the result of continuing economic and occupational barriers.

In the 1970s, there was a turnaround in migration so the South received a net gain in migrants from the North (Wilson, 2007). This movement has grown, with most returning Blacks settling in suburban areas.

In 2006–2008, Blacks numbered 37.1 million, constituting 12.3 percent of the country's population (U.S. Census Bureau, 2010a). Fifty-five percent of Blacks lived in the central cities of metropolitan areas (U.S. Census, 2004a). Blacks have the highest proportions in states of the Deep South, where they make up 20 to 55 percent of the population (U.S. Census Bureau, 2010a). Other characteristics are given for Blacks and non-Hispanic Whites in Table 7.3. The percentage of persons married reflects family stability. Blacks have a lower percentage of persons who are married and a higher percentage of persons that are separated or divorced than do Whites or Hispanics. Studies of Black families have indicated a higher proportion of single-parent families headed by the mother, compared to non-Hispanic Whites and Hispanics. This can add to the economic burden on Black families because there is only one breadwinner. It is clear that, although much progress has been made in status, including an expanded Black middle class and improving educational levels, overall a gap remains socioeconomically for the cross section of Blacks. An urban, lower-socioeconomic neighborhood in Chicago that is mostly Black is pictured in Figure 7.13.

7.6.2 Hispanics and Latinos

The Hispanics and Latinos in the United States originated from many different Latin American countries. However, of Hispanics and Latinos indicating a specific country of origin in the 2000 Census, 71 percent were of Mexican origin, followed by Puerto Rican (11.6 percent), Central American (5.8 percent), South American (4.6 percent), Cuban (4.2 percent), and Dominican (2.7 percent). This section focuses on the surges of Hispanic immigration and domestic migration after arrival. Besides Blacks and Hispanics, other ethnic groups (e.g., Greeks, Vietnamese, Russians, and Armenians) arriving in the United States have had highly interesting and unique immigration

TABLE 7.3 Selected Characteristics in the United States: Non-Hispanic Blacks versus Non-Hispanic Whites and Hispanics, 2004

Characteristic	Non-Hispanic Blacks	Non-Hispanic Whites	Hispanics
High school education, persons 25 and older	79%	89%	60%
Bachelor's degree, persons 25 and older	17%	30%	13%
Managerial, professional, and related occupations	27%	38%	18%
Median household income	$30,196	$48,784	$35,929
Poverty	26%	9%	22%
Married, persons 15 and older	34%	57%	51%
Separated or divorced, persons 15 and older	17%	12%	11%
Families with woman family head without a spouse	45%	13%	11%
Foreign born	8%	4%	39%
Total number of persons	34,772,381	192,362,875	40,459,196
Percent of U.S. population	12	67	14

Sources: U.S. Census Bureau. (2004a, 2004b). *The American Community—Blacks* (American Community Survey Reports AC-04). Washington, DC: Author; U.S. Census Bureau. (2004). *The American Community—Hispanics* (American Community Survey Reports AC-03). Washington, DC: Author. Both available at http://www.census.gov

histories, for which the reader should refer to the chapter references (see many histories in McKee, 2000a; Spain, 1999; and Miyares and Airriess, 2007).

The first Mexican Americans came along with the U.S. annexations of Texas in 1845 and of Arizona, New Mexico, California, western Colorado, Utah, and Nevada in the Treaty of Guadalupe Hidalgo in 1848 and the Gadsden Purchase of 1853, although the population in these purchased territories was very sparse. All this territory had previously been a part of the nation of Mexico since its independence in 1821 and before that a part of the Spanish colony of Mexico. During the late 19th century, the Mexican-American population expanded slowly in these annexed territories.

FIGURE 7.13 Inner-city neighborhood, Chicago. *Source*: Corbis/Bettmann.

In the 20th century, a variety of U.S. policies on immigration and economic push and pull factors had varying effects on the volume of Mexican immigration. From 1900 to 1930, there was migration, largely legal, to take low-paying jobs in the United States. From the 1940s to today, a number of U.S. government programs and laws have affected immigration. For example, the Bracero Program, which lasted from 1942 to 1964, involved legal and temporary migration of experienced Mexican agricultural workers, or *braceros,* to the United States to fill labor shortages. It was spurred originally by the farm-labor shortages in the United States stemming from the domestic workforce demands of World War II. Some *braceros* ran into resistance from racist and extremist groups in the United States. More than 3 million *braceros* entered the United States under this program. It was finally ended in 1964 because of a perceived excess of agricultural laborers and the increasing use of the mechanical harvester for cotton (Border Agricultural Workers Project, 2004).

In the late 20th and early 21st centuries, there occurred a vast and unprecedented form of migration of Mexicans to the United States. These immigrants were a mixture of legal, naturalized, and undocumented. It is estimated that more than 12 million Mexicans arrived in the United States during this time. The motivation was to fill jobs, mostly unskilled, in manufacturing, low-level services, and agriculture. Before immigrating to the United States, Mexicans often migrated first to Mexican border cities, such as Tijuana, seen in Figure 7.14. Mexican-American populations grew particularly in the border states of California, Arizona, New Mexico, and Texas. As a result, the cities today with the largest Mexican-American populations are

FIGURE 7.14 Pedestrians in Tijuana, Mexico.

Los Angeles, San Diego, San Antonio, Houston, Chicago, El Paso, Dallas, and Phoenix. All these cities, except Chicago, are in border states.

Los Angeles is a special case. By 2000, the Los Angeles CMSA, with a total population of 16.4 million, had a Hispanic population of 6.6 million, of which 5.3 million were estimated to be Mexican (Allen & Turner, 2002; U.S. Census Bureau, 2002). Los Angeles County in 2008 was 47 percent Hispanic or Latino (U.S. Census Bureau, 2010a). It is remarkable that metropolitan Los Angeles's Hispanic population grew by 1.8 million during the 1990s and by an additional 1.2 million during 2000–2007, building up the urban area as the nation's largest Latino center. This growth was due not only to migration, but also to high fertility. The enhanced fertility stems from cultural patterns in Mexico of higher fertility than in the United States. There are recent signs, however, that overall in the United States, the proportion of Mexican immigrants settling in Los Angeles is lowering, compared with the remainder of the country (Pew Hispanic Center, 2010).

One offshoot of the successive immigration surges is a cultural mixing that is quite evident in the United States–Mexico border region, a mixing that has been referred to as "MexAmerica" (Garreau, 1981; Langley, 1987) or as "Hyperborder" (Romero, 2008). This implies a blending of Mexican and American cultures to constitute a new area of North America. The mixing can be seen in cultural traditions, cuisine, mannerisms, and work habits common to both sides of the border that give greater affinity within MexAmerica than with the rest of the two countries. How far this melding will go and its ultimate form are yet unknown and might depend on future intermingling, cross-border cooperation, security tensions, drug-related crime, globalization, and new forms of economic exchanges.

Residential distributions within cities are also changing as a result of immigration. In the 19th century, for Mexican Americans in U.S. border cities, the residential location of population was around central plazas, as was true in Mexico. As border cities developed a more mixed character (i.e., Mexican Americans mixing with Anglo Americans), the Mexican-American areas near the plazas became known as *barrios,* which translates in English as "neighborhood." These neighborhoods developed a distinctive Mexican demographic composition and cultural aspect. As the border cities grew rapidly, Mexican Americans residing near plazas of adjacent towns became absorbed by the expanding cities. As a result, some barrios today are located away from the center of the bigger city (Arreola, 2000).

Another example of a largely Hispanic city is San Antonio, Texas. In 2006, the city was 61 percent Hispanic or Latino (U.S. Census Bureau, 2010a). In San Antonio, other minority groups are relatively small. It is a city demographically dominated by the Hispanic population, giving a strong cultural aspect to the city. Miami is an analogous case, but with a different cast. The metropolitan area in 2006–2008 was 39 percent Hispanic or Latino of which—16 percent were Cuban and 23 percent other Hispanic or Latino (U.S. Census, 2010a). Cubans number 887,000. Following the Cuban Revolution in 1959, a stream of

Cuban refugees immigrated to Miami. Subsequently, Cuban migrants were attracted to Miami from other major American metropolitan areas (Gober, 2000). On average, the Cuban community in Miami has done very well, with the second generation increasingly moving into the middle class and city leadership (Portes & Stepick, 1993). Miami has many Cuban neighborhoods that reflect cultural traditions, such as Little Havana. It is an example of transplanted culture, with acquisition of some American characteristics and retention of others that are Cuban.

In summary, Hispanic and Latino immigration has grown as a factor in the United States ever since the abrupt annexation and purchase of a large part of Mexico more than 155 years ago. Waves of immigration have occurred that have depended on economic factors, labor shortages, and in the case of Cuban immigrants, forced refugee streams. The Hispanic and Latino population in the late 20th century settled predominantly in major cities in the border states, Miami, New York, and Chicago. However, that pattern today is changing with settlement across a broad variety of medium-sized cities, many in the South and Midwest (Pew Hispanic Center, 2010; U.S. Census Bureau, 2010a).

7.7 RACIAL SEGREGATION

Racial segregation was defined earlier in the chapter as a geographic overconcentration of a particular racial group. It is often accompanied by the intent by parties to create or maintain segregation. This can include exclusion by one party of another from jobs, education, housing, social privileges, and economic assets.

There are also noncoercive factors that influence persons of the same race or ethnicity to live in close proximity to other similar persons. These factors include similarities in culture and language; social networks; and support for settlement, acculturation, and assimilation. Most of these factors have to do with immigrant or migrant groups, which can adjust and find greater support in segregated areas. An example of cultural factors in segregation would be Italian communities that are present in many U.S. cities; people of Italian background might value the support networks, common cultural and language features, and greater social networking opportunities, and thus prefer to live in somewhat segregated Italian neighborhoods.

Racial segregation was present in the United States at its origins; slavery existed here from 1619 until 1865. After the Civil War, legal segregation of Blacks continued for many decades, until changes resulted from the civil rights movement of the 1960s.

Other ethnic groups have also experienced varying extents of segregation. In recent decades, Latinos and Asians have been segregated residentially, although not to the same degree as Blacks. Earlier in the country's history, Jews experienced residential segregation; were segregated socially by exclusion from certain organizations such as social clubs; and were restricted from some universities, colleges, and to some extent, high-level professions. In the 19th century, American Indians were segregated onto reservations, and many remain so today in a lesser form. Segregation has occurred in many other nations also. In extreme forms, it was present for Jews in 1930s Germany and for Blacks, Indians, and mixed-race groups in South Africa. In milder forms, it is present, for example, in Mexico for indigenous people and in Turkey for Kurds.

Residential segregation can be analyzed geographically. Determining its distribution of intensity across cities and within cities can help us to understand how segregation occurred, what its impacts are on communities, and what policies can help resolve it.

A widely used measure of racial segregation in U.S. cities is the index of dissimilarity. Several studies done in the 1990s and early 2000s introduced this measure for studying the urban geography of U.S. cities (Darden, 2001; Massey & Denton, 1993). An example compares each major ethnic group with the non-Hispanic White population. Using this index, all of the major metropolitan areas in the United States in 1990 (Darden, 2001) show Blacks to be the most segregated (index value 68), followed by Hispanics (46) and Asians (41). The index values for these three groups are shown in Table 7.4 for the 15 largest metropolitan areas. As a reminder, a value of 0 means no residential segregation, and a value of 100 implies complete segregation (i.e., separation). For both Hispanics and Blacks, segregation is higher in cities with a larger percentage of the target minority group (the correlations between the segregation index and percentage in a minority group are 0.50 and 0.62, respectively). An example is the New York primary metropolitan statistical area (PMSA), which had relatively high percentages of around 22 to 23 percent for both Blacks and Hispanics and concomitant high segregation indexes of 86 and 63, respectively. PMSA was a concept used in the U.S. 1990 Census, but not continued for 2000 or subsequently. There were distinctive areas in 1990 in New York for most of the populations of these groups. Asian segregation varies less among cities, and there is little, if any, relationship with Asian presence.

Similar types of segregation comparisons can be made between cities and suburbs, between distinctive parts of the central city, and among cities in different nations, although differences in international definitions require that such comparisons be made carefully.

Regarding Black segregation, studies have pointed to housing as the key intermediate "gateway" device that determines the extent of segregation. In a huge study of Black segregation that focused on the largest U.S. metropolitan areas in 1990, Massey and Denton (1993) found that White citizens were willing to accept into their neighborhoods only a limited proportion of Blacks, and they identified the housing barrier as the critical one (Massey & Denton, 1993).

This has persisted in spite of the passage in 1968 of the U.S. Fair Housing Act and subsequently in 1988 of the U.S. Fair Housing Amendments Act, which strengthened the enforcement mechanisms of the original act. The 1968 act made it illegal for White real estate agents to prevent Blacks from living in a particular neighborhood of the city in any way. Although Whites accepted this law, they have mostly not put into practice its provisions (Darden, 2001). For example, the way around the law for some White real estate agents is a technique called *racial steering*. In this method, agents steer away Black home buyers

TABLE 7.4 Racial Residential Segregation Indices in the 15 Largest U.S. Metropolitan Areas, 1990

	Black Segregation Index	Black Percentage of Population	Asian Segregation Index	Asian Percentage of Population	Hispanic Segregation Index	Hispanic Percentage of Population
Los Angeles–Long Beach, CA	73	10.5	46	10.2	61	37.8
New York, NY	82	23.2	48	6.2	66	22.1
Chicago, IL	86	21.7	43	3.6	63	12.1
Philadelphia, PA–NJ	77	18.8	43	2.1	63	3.6
Detroit, MI	88	21.4	43	1.3	40	1.9
Washington, DC	66	26.2	32	5.0	41	5.7
Houston, TX	67	18.1	46	3.7	49	21.4
Boston, MA	78	6.0	37	3.0	36	5.0
Atlanta, GA	68	25.8	40	1.8	34	2.0
Riverside–San Bernardino, CA	44	6.5	33	3.6	36	26.5
Dallas, TX	63	15.8	41	2.5	50	14.4
San Diego, CA	58	6.0	48	7.4	45	20.4
Minneapolis–St. Paul, MN–WI	62	3.6	41	2.6	35	1.5
St. Louis, MO–IL	77	17.2	38	0.9	23	1.1
Anaheim–Santa Ana, CA	37	1.6	33	10.0	50	23.4
AVERAGE	68	14.8	41	4.3	46	13.3

Note: The segregation index is 100 times the index of dissimilarity for minority groups, compared to the nonminority (White) population, as defined in this chapter. The metropolitan areas are not consolidated ones.

Source: Darden, J. T. (2001). "Race relations in the city." In *Handbook of Urban Studies,* edited by P. Ronan, pp. 177–193. London: Sage. (Based on data from the U.S. 1990 Census.)

who are seeking a home in a predominantly White neighborhood; likewise, the agents steer White home buyers away from Black areas. Racial steering is difficult to monitor, so it persists even though it is illegal. It is difficult even to study because it requires a large sample to identify the Black–White differences. This can be done by a method called *paired testing* (Darden, 2001; U.S. Department of Housing and Urban Development, 2002). Here the researchers role-play being Black and White buyers. Each is set up with fictitious demographic and socioeconomic characteristics (e.g., family size, income, and age) that on average are similar between races. Each buyer approaches several actual real estate agents (even the same ones) about buying a home in a segregated neighborhood they do or do not racially match. The extent of success for each is measured and compared. These studies have consistently demonstrated that many real estate agents engage in such discriminatory steering (Darden, 2001). A large-scale paired testing study (U.S. Department of Housing and Urban Development, 2002) indicated that discrimination in the renting of housing was present in 22 percent of test cases for Blacks and in 25 percent of test cases for Hispanics. The good news was that the percentage for Blacks had declined from 26 percent in a comparable study in 1989. However, another study in the South indicated that most Black students attend schools where the enrollment is predominantly minority and that the schools with large minority enrollments tend to have high poverty, pointing to a significant challenge ahead (Wilson, 2007).

Through steering and other real estate techniques, Blacks have experienced lowered opportunities to move out of the central-city ghetto into White areas. The result reinforces and increases segregated communities for Blacks and Whites. Some interest groups are concerned about these barriers and are working to attack and lower them.

Geography is crucial to understanding these and many other forms of segregation because residential segregation involves a form of physical separation—and hence a geographic perspective. GIS is a good tool for governments, affected parties, and interest groups to use to see how and where segregation has occurred and how resources can be best deployed to mitigate it.

7.8 EMERGING ETHNIC HOT SPOTS IN THE SUBURBS

As a result of changes in the 1990s, America is undergoing a further shift in its metropolitan-nonmetropolitan balance that is altering the urban experience and lifestyles for many people. This section considers how cities or metropolitan areas have been affected by the immigration shifts already discussed, how the balance of suburbs versus central city is changing, and how ethnic minorities have become more prevalent in suburbs as a consequence. Finally, it looks at a new trend of departure of White population from suburbs to what Frey (2002a, 2002b) called *exurbs*—that is, small cities with natural and cultural attractions, removed from the big cities, in states such as South Carolina and Oregon.

Necessary background for understanding these changes is the hypothesis put forward in the mid-1990s by demographer

William Frey of a "new demographic Balkanisation" (Frey, 1995). This refers to the classification of cities and states in the United States based on very distinctive characteristics—that is, as separate areas, or Balkans, deriving from the very distinctive countries in the Balkan region (Frey, 1995). This concept implies unevenness in ethnic and racial diversity across the states and cities. Frey (1995) put forth the following categories of metropolitan areas (or states):

1. ***High-immigration metropolitan areas:*** Metropolitan areas with high levels of immigration from overseas during the period 1985–1990. This group is typified by Los Angeles, New York City, San Francisco, and Miami. Frey (1995) termed them the new "ports-of-entry" into the country.
2. ***High internal migration metropolitan areas:*** Metropolitan areas that grew more from a high level of domestic migration from other parts of the United States than from immigration from abroad. Examples of these metropolitan areas are Atlanta, Tampa–St. Petersburg, Seattle, and Phoenix.
3. ***High out-migration metropolitan areas:*** Metropolitan areas that experienced high flows of out-migration, without compensating inflows of immigrants. They tend to be cities suffering from the loss of manufacturing or cities affected by the late-1980s oil bust. Examples are Detroit, Pittsburgh, Cleveland, and New Orleans.
4. ***Other metropolitan areas:*** Metropolitan areas that cannot be classified in the other three categories. They depend on other patterns. Instances are Columbus, Ohio; Minneapolis–St. Paul; and Indianapolis.

The four metro area types are distinctive. The ports of entry tend to be more diverse ethnically and more dynamic than the others. This has major implications for the future. For instance, if ports of entry continue to receive large immigration flows, those cities might foster greater creativity and experience higher productivity (see Florida, 2002). At the same time, they have been susceptible to the White flight of lower-socioeconomic Whites. "Immigrants are displacing internal migrants at the lower rungs of the socioeconomic spectrum" (Frey, 1995, p. 746). Population is leaving the old manufacturing belt (i.e., part of type 3) and is tending to migrate to ports of entry. This could be partly due to the fact that some ports of entry are located in more favorable climates. The more detailed components of internal and foreign migration from 1985 to 1990 are shown for certain metropolitan areas from types 1 and 2 in Figure 7.15.

The theory of demographic Balkanization has been influential in understanding the shifts from the much larger volumes of immigration in the 1980s, 1990s, and early 2000s. It sets the stage for understanding the central-city, suburban, and exurban fluxes. In the 1990s, the suburbs became much more ethnically and racially diverse as the overall proportion of the ethnic minority population in suburbs expanded from 19 to 27 percent (Frey, 2001). The implication is that the old concept of suburb is outdated. Ethnic groups are becoming very prevalent in suburbs. Some studies considered suburbs and central city no longer distinct on some measures of diversity. In one study, the suburban rings and central cities of 65 large metropolitan areas resembled each other on diversity for age, household type, education, income, and residential duration, although central cities were much more diverse on race, home ownership (tenure), and nativity (Hall & Lee, 2010). Diversity in the central city occurs both between and within neighborhoods; retention of the historical diversity of American central cities will be strongly influenced by neighborhood stability or change. This was seen in the many forces for change impacting six diverse neighborhoods in Chicago (Talen, 2010).

A ramification for suburbs is that certain Whites are being displaced from them; rather than returning to the central city, in the 1990s they migrated to what Frey (2001) called *exurbs*. He defined an exurb as a small- to medium-sized city located in one of the 13 "national-suburban" states (Frey, 2001), such as South Carolina, Oregon, and Washington. "These white losses [from the suburbs] reflect mostly young people, married couples, parents, and new retirees heading to the 13 new 'national-suburban' states—where they seem to be seeking new lives rooted in more old-fashioned values" (Frey, 2002b, p. 43).

The nation is slowly changing on the basis of a changed suburbia, with a higher proportion of minority groups and the outward spread beyond suburbs to *exurbia* (Frey, 2001). This section illustrates that the geographic aspects of ethnic change never seem to stop changing. What had been standard ethnic migration patterns for a half-century have now changed, altering the typology of metropolitan areas, readjusting the balance of immigration versus domestic migration, shifting ethnic and racial balances in central cities, creating more ethnic and racial diversity in the suburbs, and leading to White flight to exurbia, dispersed small cities beyond the big metropolitan areas.

7.9 GENDER

This section discusses the emerging understanding of gender and sexuality in the city and a feminist view of GIS (Hanson, 1992; Johnson, 2008; Kwan, 2007). Some feminists have been skeptical about the value of GIS for understanding gender and other social phenomena of concern to them, although some examples of GIS use have enhanced the study of gender (Kwan, 2002a, 2007).

Gender is a term that describes aspects of being male or female that are socially determined (Pain et al., 2001), whereas *sex* refers to male–female biological differences. Traditionally, masculine traits were associated with the workplace, competition, public activities, and monetary rewards, whereas feminine traits were related to the home and its private and emotionally based activities. As seen in Table 7.5 (see page 222), the traditional view of feminine traits versus masculine ones implies less power and reduced social and spatial mobility. The greater power traditionally given to men versus women is sometimes referred to as *patriarchy*—in particular, a political and socioeconomic system in which men have more power and control than women. Patriarchy is often regarded as having domination and being able to subordinate others, determined through the intersection of race, age, class, sexuality, and gender, not just gender alone.

Feminism is the theory of the political, economic, and social equality of women. Although centuries old, it was energized

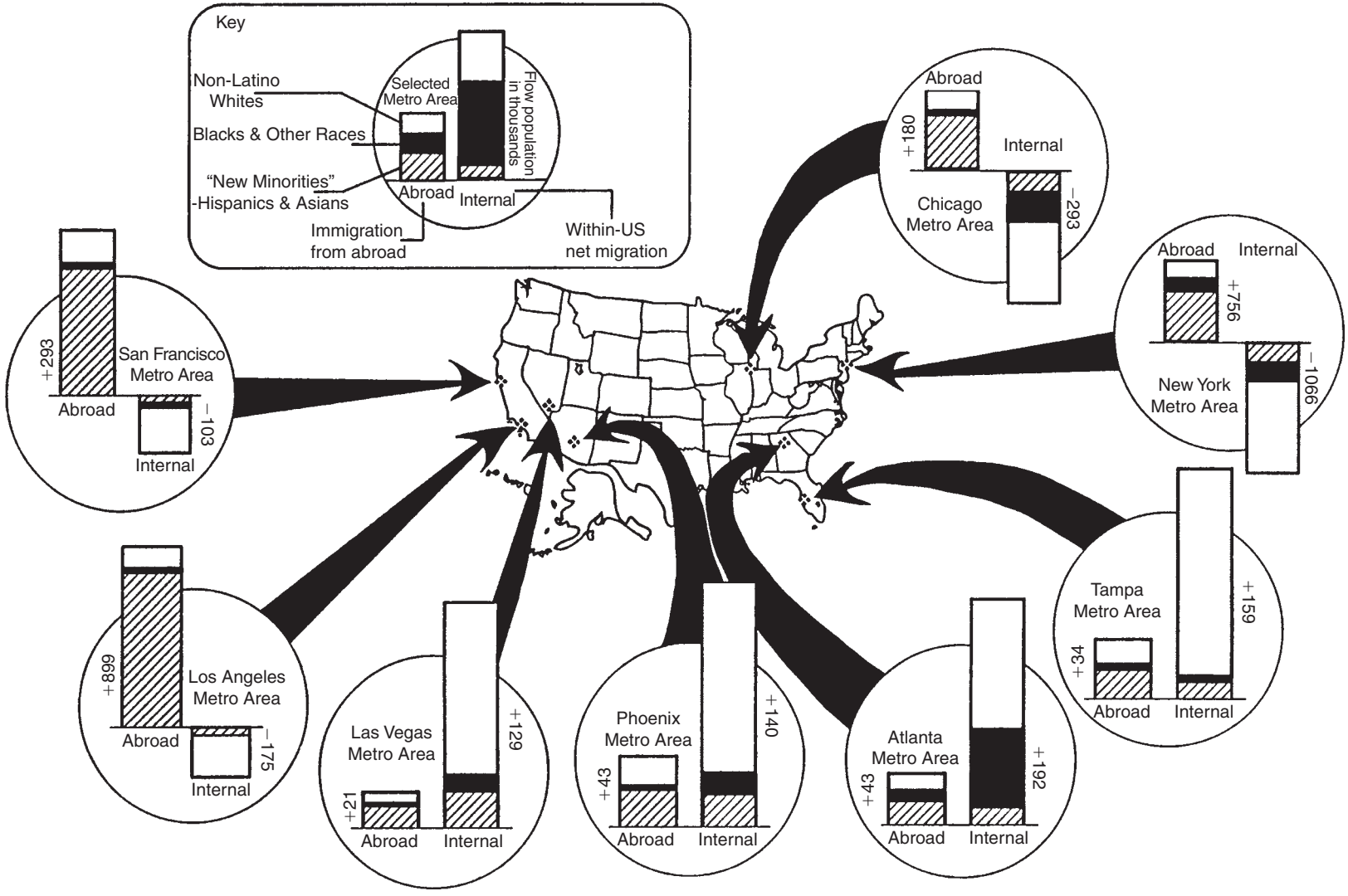


FIGURE 7.15 Foreign and internal components of migration, selected port-of-entry metropolitan areas, 1985–1990. *Source*: Frey, William H. 1995. "Immigration and Internal Migration 'Flight' from U.S. Metropolitan Areas Toward a New Demographic Balkanisation." URBAN STUDIES 32(4–5). Copyright © 1995, Urban Studies Journal Limited. Reprinted by Permission of SAGE. Figure 3. P. 741. "Migration components for selected high immigration metros and high internal migration metros, 1985–90."

TABLE 7.5 Gender: Traditionally Masculine and Feminine Traits

Masculine Traits	Feminine Traits
Public	Private
Outside	Inside
Work	Leisure
Rational	Emotional
Earning	Spending
Production	Consumption
Dominant	Subordinate
Empowered	Disempowered
Freedom	Constraint

Source: Pain, R., Barke, M., Fuller, D., Gough, J., MacFarlane, R., and Mowl, G. (2001). "Geographies of gender and sexuality." In *Introducing Social Geographies,* pp. 120–140. London: Arnold. Box 6.3, p. 122. (Modified from McDowell, L. and J.P. Sharp. 1999. A FEMINIST GLOSSARY OF HUMAN GEOGRAPHY. New York: Oxford University Press, www.oup.com. Reprinted by permission of Oxford University Press, Inc.

by the women's liberation movement of the 1960s. Feminist geographers are particularly concerned with gender issues and have developed a considerable amount of knowledge, especially over the past two decades (Johnson, 2008). *Sexuality* in this context refers to the social aspects of being sexual. The interest of urban geographers has been on how sexuality influences cultural, economic, and social geographies and how they in turn influence sexuality (Pain et al., 2001). The focus in urban geography studies of sexuality has been on the social aspects of sexual orientation (Pain et al., 2001), race and sexualities (Johnson, 2008), and sexuality in urban transitions (Sun, 2008).

Geographic studies of gender have included the following aspects among others: the impacts of gender inequality; the explanations of gender inequality related to patriarchy; gendered identities; gender and public space; paid and unpaid work; emotions; the space–time continuum of women's and men's lives; oppression; activism; and social reproduction, that is, the perpetuating of social structures, sexualities, and embodiment (Johnson, 2008; Pain et al., 2001). The concept of embodiment emphasizes the relationship of the human body as part of urban space, rather than just financial and material aspects (Kwan, 2007).

The roots of contemporary gender differentiation in urban space are found in the late 18th and 19th centuries in Europe, at the time of the Industrial Revolution and growing waged labor, often backed by trade unions. These trends led women to become more restricted in urban space. Many studies emphasize the importance of space—for instance, studies on what the public spaces in cities are in which women feel unsafe or threatened and on women's daily spatial movements, relative to home, work, power, and fear. Sometimes studies have pointed to women's *spatial entrapment*—in other words, the perception that they are not welcome in parts of the urban landscape and so remain trapped in narrower segments. This relates also to women's commute times from home to work, which studies have indicated are shorter on the average than men's, implying smaller space ranges, as well as the necessities of keeping track of children and fulfilling home roles (Mitchell, 2000).

Another feminist theme in urban geography studies has been women's and men's bodies (Kwan, 2007; Mitchell, 2000). For instance, the body is an important aspect in U.S. shopping centers, including the display of pictures of bodies, and in many venues that involve the body (Longhurst, 1998). Women are often more socially identified with their bodies than are men (Mitchell, 2000). Another perspective is that the urban location of a person's body can be tracked throughout the day or week as it relates to social, emotional, and ethical phenomena (Kwan, 2007).

The methods that urban feminist geographers use include analyzing distance and measures of separation, studying localities by gender and sexuality, examining the body related to its geographies of the body, conducting interviews, doing ethnographic fieldwork, and applying GIS methods in a personal way different from its normal use.

Several specific studies of gender considered here are women and public places, gender aspects of the high-technology industry, and gender and sexuality in the urban space in Beijing. Women are known to have more fear of public places than do men (Day, 2001; McDowell, 1997, 2001). This fear stems from real data on experiences and incidents that have occurred, as well as other types of communications about fear, including media warnings and advice and protectiveness from men (Day, 2001). Women's specific public-place fears are of sexual assault, harassment, crime, sex discrimination, and hate crime (Day, 2001). Women's reactions to these real or perceived threats include avoiding particular public spaces at specific times (McDowell, 1995, 1997; Starkweather, 2007); requesting escort and protection by men (Day, 2001); changing modes of transit; adopting more traditionally masculine behavior, such as learning physical self-defense; and engaging in activism, protests, and other political activity.

In a study of women's fear of urban parks termed the Woods Project, Burgess (1998) sought to determine why women feared woodlands on the outskirts of British cities. One-gender-only group discussions were conducted with respondents at two urban woodlands, Bestwood Country Park on the urban fringe of Nottingham, England, and Bencroft-Wormly Woods on the northern fringe of London. The women and men were both woodlands visitors and nonvisitors from different ages and socioeconomic classes. From a physical point of view, the parks' enclosures of trees and plants, reduced visibility, dark areas, and narrow paths could increase fear. On the social side, women's encounters with strangers and threatening or violent behavior have grown. Even flashing was a reported problem, leading to varied reactions, including anxiety and outrage (Burgess, 1998). Furthermore, the mass media coverage of events in the parks was very influential on respondents' perceptions and levels of fear. This study also suggested ways visitors to the parks, particularly women and ethnic minorities, could cope with their fear, ranging from "voluntary self-exclusion and not visiting the greenspace at all to taking a dog, children, a friend, male partner, or son, so that one is not going alone" (Burgess, 1998, p. 127).

A study of over 400 Ohio University undergraduates showed that, although most students felt safe in the space of the campus, men and women wavered between sometimes different and sometimes similar emotions, reactions, and strategies to cope with safety (Starkweather, 2007). The difference was that men tended to take fewer avoidance actions when walking

around in the space. Many men did not react to safety fears, considering it a "women's issue." In precautionary strategies such as "heightened awareness and plan-making," men and women were similar (Starkweather, 2007).

A study by Massey (1998) examined the space–time patterns of mostly male scientists and engineers in the high-tech industry of Cambridge, England. These highly skilled and educated workers put in very long hours—to the extent of being workaholics—and were absorbed in gaining the latest knowledge and responding to very tight deadlines in highly competitive markets. Their work environments were well ordered, abstract, and logical—in other words, masculine—in contrast to their emotional and leisure-oriented homes. The study, based on in-depth interviews, showed that the space–time of the workplace "transgressed" into the home sphere (Massey, 1998). For instance, respondents reported that such workers typically brought their work home, even after long hours in the workplace. They were often distracted by work even when engaged in home-centered social activities and caring for children. They were mostly unmindful of and nonparticipative in household work (Massey, 1998, p. 167). Massey referred to this as a "spatial split between mind and body" (p. 167). A small minority of the workers were "resisters" in that they did not bring work home, but it often increased their hours spent in the workplace. This study raises difficult issues that include the value of such highly skilled cutting-edge work to the worker and society versus its social and family costs. Another issue is how compartmentalized people's lives should be spatially and temporally. The few high-tech workers among the housewives of the male scientists and engineers highlighted these differences. Unlike their husbands, they seemed to merge rather than partition the space–time of work and home.

An early theme among some feminist geographers was a divide between their scholarship and GIS. Some criticized GIS as being too logical and coming from a male-dominated environment, based on technology originating from government and the military, while others have incorporated it in different ways. For instance, a study showed a mixed result from GIS adoption by women activist groups: In some cases, the GIS knowledge empowered them to achieve their goals, but in other cases, it hobbled their efforts (McLafferty, 2002; Timander & McLafferty, 1998). Kwan (2002b) pointed out that the key to making GIS relevant is to shift its use toward interpretation, visual images, and narrative. She demonstrated this in her own studies of the daily life paths of women in Columbus, Ohio (Kwan, 2002b), and Portland, Oregon (Kwan, 2002c). As seen in Figure 7.16, she utilized special 3-D displays and algorithms tailored to variables in the urban environment confronting women to display space–time paths during the day (Kwan, 2002a). The key was gathering unconventional travel diary data and tailoring new algorithms to analyze it.

A personal pathway can be recorded by combining a global positioning system (GPS) with a GIS. Video artist Lisa Parks has recorded aspects of journeys to California and Australia that are keyed to GPS-based map locations and are used in narratives and storytelling (Kwan, 2007). Emotions can be added in 3-D GIS videography. Kwan accompanied a Muslim woman after the 9/11 attacks to record the woman's everyday spatial pathway and feelings along the way about places and about buildings. "Her movement is portrayed as a personalized space–time trajectory that is color-coded to reflect the level of fear and perceived danger she experienced." This videography displays the route with color-coded buildings, depending on emotion along with the woman's audio narrative (Kwan, 2007).

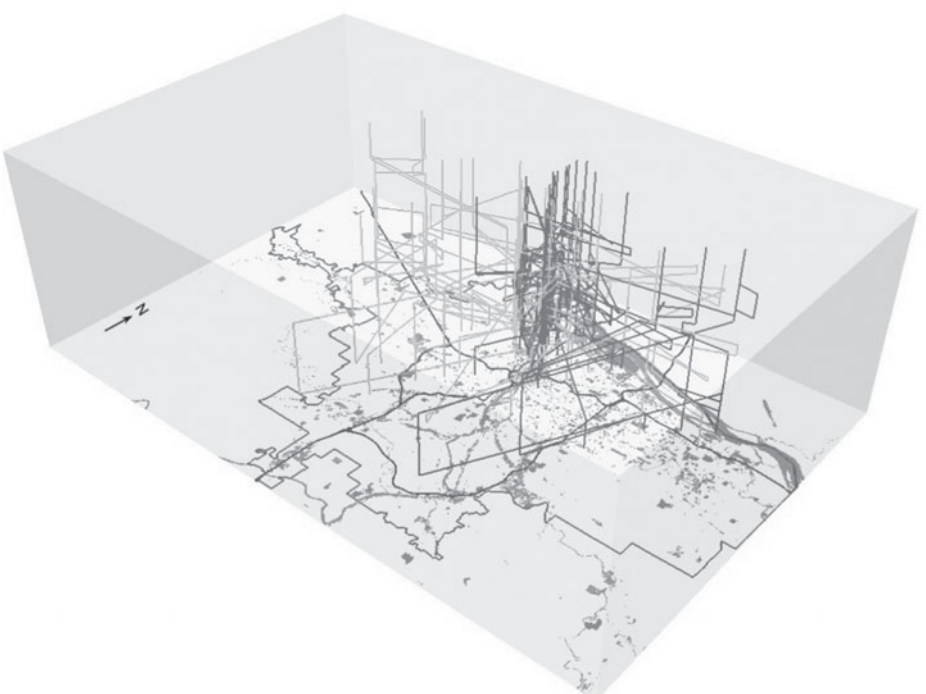


FIGURE 7.16 Space–time paths of a sample of Black women in Portland, Oregon. *Source*: Kwan, M.-P. (2002) ANNUALS OF THE AMERICAN ASSOCIATION OF GEOGRAPHERS 92(4): 645–661. Reprinted by permission of Taylor & Francis Group UK and the author. Figure 1. P. 614. "Feminist Visualization: Re-envisioning GIS as a Method in Feminist Geographic Research."

Studies of sexuality in urban geography started in the 1980s by examining gay and lesbian places and networking (McNee, 1984, 1985). This has continued in a substantial line of research that has concerned the topics of "gay community development, territoriality, neighborhood change, gentrification, social movements, urban politics, and the cultural politics of urban space as they pertain to sexuality" (Brown & Knopp, 2003, p. 317). Like studies of gender, much of the study of sexuality has been conceptual and qualitative, although a few studies have been empirical (Brown & Knopp, 2003). Other types of urban geography studies of sexuality include examining residential architecture as conforming to a heterosexual, nuclear family (Valentine, 1993a), studying the heterosexuality dominance of layouts of home spaces (Valentine, 1993a, 1993b), and examining sexuality in cities in a broader sense of including all types—heterosexual and homosexual (Nast & Pile, 1998).

An example of an early study of gay neighborhoods in San Francisco (Castells, 1983) shows the large areas by the mid-1980s in downtown San Francisco having gay settlement, as well as the years that settlement originally occurred (see Figure 7.17). The city might have developed its large gay communities originally through its role as a seaport, which brought a population with more men than women and many transitory residents (Mitchell, 2000). Over time, the city also developed a reputation of having bohemian sections that might have attracted gays and lesbians to immigrate. The center of the gay (and to a lesser extent, lesbian) area of San Francisco is Castro Street, shown in the middle of Figure 7.17. These groups often live in gentrifying areas and contribute to gentrification (Brown & Knopp, 2003; Mitchell, 2000). For San Francisco, this led to rising housing values. As a consequence, low-income community members could be forced to leave.

Recent feminist studies of third-world and first-world interactions have focused on the social, emotional, and spatial transitions of Chinese rural women who migrate to Beijing (Gaetano, 2008; Sun, 2008). The women are unaccustomed to the sophisticated people, high consumption levels, customs, and fast pace of the metropolis. The single, newly arrived migrant does not have *hukou* status, needed for official residence, which increases the barriers to acceptance. One study (Sun, 2008) focused on consumption and use of space for rural-migrant, female domestic workers in Beijing. They lived in shabby single rooms or dormitory-like building basements, traveled by bike or on foot, and received low pay. A part of their adjustment was bargain-hunting consumption in Beijing's global retail sector; they would make token or even no purchases, yet be able to identify more with the big city. The "guerilla shopper" mentality strengthened them for the urban challenges. Their use of space was in the "latent geography" not visible to the established resident. They could learn to get around the traffic-jammed city often even faster or easier than the wealthy urbanite by knowing intricate bicycle and foot routes not available to vehicles.

Another study of this migrant group (Gaetano, 2008) focused on how these migrants might negotiate sexuality in the challenging new environment and utilize marriage as a bridge to acceptance. Many demanded a future husband of "good condition" so they would increase the chances of an enduring and happy relationship and achieve greater control in the marital household. "Rejecting rural identity and all that it signifies, they embrace a more sexualized, urban femininity" (Gaetano, 2008, p. 641). The feminist perspective of this pair of studies is helpful to broaden concepts of the gender aspects of the social and spatial milieu of Beijing and of how rural women migrants adjust to it.

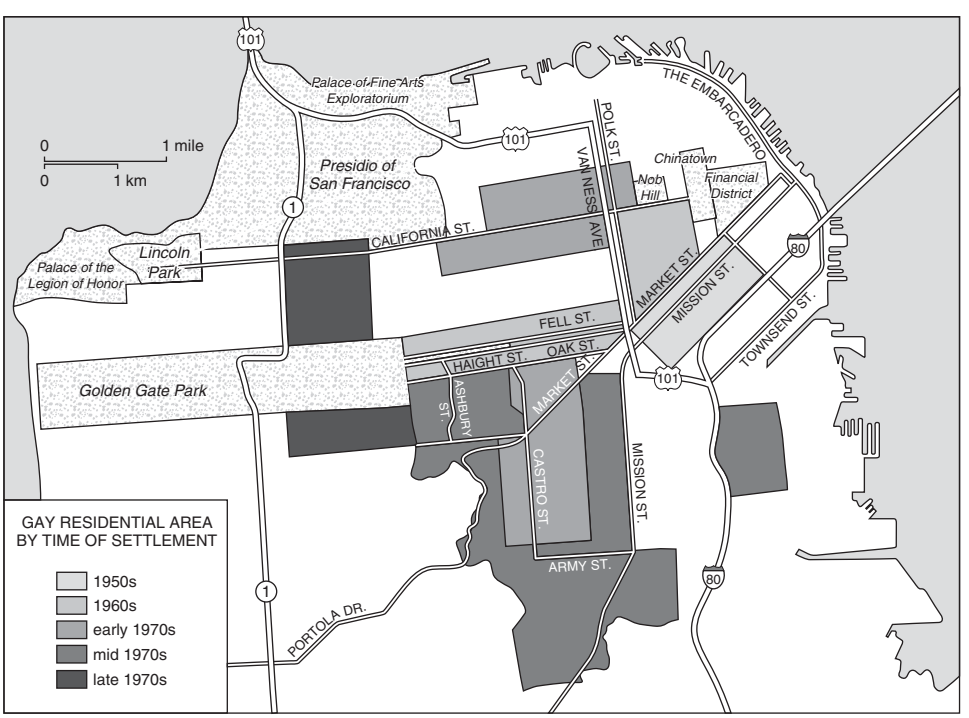


FIGURE 7.17 Gay neighborhoods in San Francisco. *Source*: Mitchell, D. 2002. CULTURAL GEOGRAPHY: A CRITICAL INTRODUCTION. Copyright © Donald Miller 2000. Reproduced with permission of Blackwell Publishing Ltd.

In summary, gender is a key aspect of the social life of cities that has been receiving increasing attention from urban geographers. The knowledge of many aspects of gender and sexuality has grown. Although early scholars could not find appropriate uses for GIS, recently new data and techniques show the value of its use in gender studies.

7.10 POVERTY AND ITS MEASUREMENT

The chapter turns for its remainder to look at poverty, its role in cities, and its geography. Poverty is defined as the status of a person, household, or family that lacks a usual or socially acceptable amount of financial assets or material possessions. It is an important topic in urban geography because it is present in virtually every city. It represents a lifestyle that usually restricts opportunities and implies costs to government. Poverty is influenced by changes in the economy and its labor markets. For example, changes in technology might reduce or eliminate certain types of jobs, such as typesetter, pressuring some members of occupational groups under the poverty line. Recessions tend to amplify the percentage of a country's population that is in poverty. Neighborhood transitions can reduce or increase poverty (Wu, 2007). Poverty can enter into politics as governments and politicians try to address or combat it (Baud, Sridharan, & Pfeffer, 2008). The definition of poverty varies, depending on the particular historical time and culture. It also is defined differently across nations.

The U.S. definition of poverty was established at the beginning of the War on Poverty in 1963, although the specific statistical cutoffs have been raised regularly in response to inflation. It is based on the concept of a minimal "basket" of basic living items for a family. It has been updated by applying inflation indexes since 1965 and is still in use today. Under the definition, a family is classified as poor if its income falls under an appropriate poverty threshold (U.S. Census Bureau, 2009a). The thresholds are arrived at by estimating the average cost for a meal plan that is nutritionally balanced, and, for a family, multiplying it by 3 to determine the threshold (Lichter & Crowley, 2002). There are adjustments made for family sizes and ages, the combinations of which results in 48 thresholds (U.S. Census Bureau, 2009a, 2009b); the threshold is lower for smaller families with fewer children. A family's income is measured against the thresholds. Since the mid-1960s, the U.S. poverty definition has been adjusted each year for inflation based on the Consumer Price Index (CPI).

As seen in Table 7.6, for 2008, the poverty threshold for a family of four with two children under 18 was an annual income of $21,027. In 2009, 43.6 million Americans were in poverty by this definition, or 14.3 percent of the population of 304.3 million (U.S. Census Bureau, 2010c). This rate was elevated by occurring towards the end of the Recession of 2007–2009 and was equivalent to levels near the end of the 1984 and 1991 recessions.

The U.S. poverty measure classifies each family into one of just two categories: poor or nonpoor. It provides no way to recognize a family that is just above or just below the threshold. This can be overcome by using a depth-of-poverty measure. *Depth of poverty* is defined as the ratio of a family's income to its poverty threshold. For example, Family X's income is $16,500.

TABLE 7.6 Poverty Income Thresholds in 2008

Family Size and Number of Children	Income Threshold for Poverty
One person over 65 years	$10,326
One person under 65 years	$11,201
Two people with head of household under 65 years	$14,417
Four people with two children	$21,834
Four people with no children	$22,207
Eight people, including four children	$37,744
Nine or more people, including two children	$47,915

Source: U.S. Census Bureau. (2009c).

The family's poverty threshold is $17,500. The depth of poverty is calculated as follows:

$$\text{Depth of poverty} = \frac{\text{Income for Family X}}{\text{Poverty threshold for Family X}} = \frac{\$16{,}500}{\$17{,}500} = 0.943$$

The U.S. definition is primarily an *absolute poverty standard,* in that it is based on a fixed bundle of economic necessities and its dollar amounts are absolute. However, it is not strictly absolute because it is adjusted over time based on national averages. Some nations measure poverty using a relative standard. A *relative poverty standard* determines poverty by the percentage of population underneath the average income or average consumption of a nation or by some multiple of average income or average consumption. An example is Mexico, which does not have an absolute poverty standard. For Mexico, one relative poverty standard is computed as the proportion of Mexicans below the average income. Another relative measure is the proportion of working Mexicans with no income or with salaries below the national minimum wage, which we define as low income. In 2000, this latter relative measure was 20.7 percent, which showed one-fifth of the Mexican working population in relative poverty.

The spatial distribution of 2000 poverty in the Mexico City metropolitan area, according to this definition, is shown in Figure 1.7. It is clear that there is a huge contrast in poverty in different parts of the metropolitan area, ranging from 6 percent to over 50 percent. The zones with the least poverty are in the sectors that extend from the central city to the northwest and east, as well as in a few scattered *municipios* to the north and south. The areas with the highest poverty levels are semirural *municipios* in the far northeast and southeast. These *municipios* represent a mixture of rural poverty and that of recent immigrants, who in Mexican cities settle on the periphery. Mexican poverty often involves makeshift housing, as seen in Figure 7.18. Many Mexican workers in poverty are not part of the salaried labor force, but are in the informal labor force, which refers to very small enterprises that do not register with the government, such as the street vendor shown in Figure 7.19.

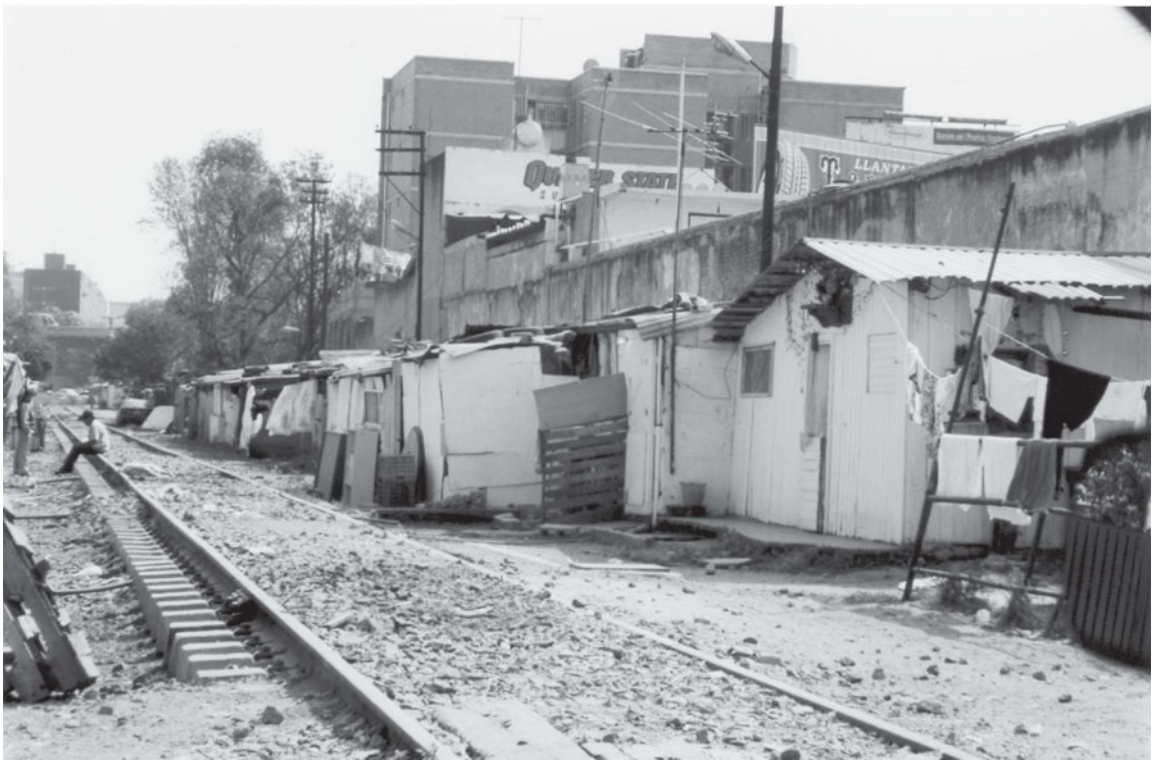


FIGURE 7.18 Mexican urban poverty: Makeshift housing.

FIGURE 7.19 Street vendor, Mexico City.

Relative poverty measures are useful in comparing among nations or among cities in different nations. Data on a fixed bundle of economic assets are rarely available across a large sample of different countries; also, these data would be of limited applicability unless living costs were alike in all the countries. The comparative poverty data for 27 selected countries reveal higher poverty rates in Africa and South America and lower poverty rates in North America, Europe, and China (Table 7.7). In this table, the third column gives the poverty rate as measured by each separate country. The fourth column indicates a crude measure of poverty based on an income of less than U.S.$2 per day, a measure that does not adjust for cost of living. The national percentage of urban population is oppositely related to the two poverty measures, so a more urban nation listed in the table is likely to have lower poverty.

The United States is seen to have a poverty rate roughly equivalent to the rates of the northern European nations of Belgium and the United Kingdom. European nations benefit from comprehensive, national social welfare programs that exceed anything provided in the United States. China's own measure shows a very low poverty rate of 8 percent, while the crude measure indicates 36 percent. The difference may derive from the Chinese government's view of the poverty threshold as high, while by rough international economic comparison the crude poverty rate is elevated. It is difficult for governments to control poverty in large, sprawling nations such as China and the United States. There are many different regions that require varied approaches to reducing poverty, so mitigation programs are more complex. Antipoverty programs are challenging to deploy across vast reaches (Smeeding, Rainwater, & Burtless, 2001). This also applies to the large nations of Nigeria, India, and Russia. India, at 25 percent poverty by its own measure, has the largest population in poverty in the world—293 million in 2009, of which an estimated 85 million are urban. India's poverty in its largest cities is known to be spread out in poverty "hotspots." For the Delhi metropolitan area, a GIS can be utilized to identify the most severe poverty hotspots, which are located in city wards to the northeast (Baud et al., 2008). Poverty was divided into components of social, human, financial, and physical capital, which were found to be positively correlated with each other, but surprisingly, except for financial capital, were not related to the location of large "slums." An implication is that the worst urban poverty in Delhi is spread out in pockets, rather than being concentrated in large slum zones (Baud et al., 2008).

TABLE 7.7 Comparative Poverty in Nations, 2005–2007

County	Percentage Urban, 2009	Percentage of Population Below the National Poverty Line, 2006 or 2007	Percentage of Population Living at Less than U.S. $2 per Day, 2005
Nigeria	47	70	84
Swaziland	24	69	81
Tajikistan	26	60	51
Bolivia	65	60	30
Guinea	33	47	87
Peru	76	44	19
Cote d'Ivoire	48	42	47
Ecuador	63	38	20
Benin	41	38	75
Myanmar	31	33	NA
Georgia	53	31	30
Armenia	64	26	43
India	29	25	76
Argentina	91	23	11
Iran	67	18	8
Portugal	55	18	0
Indonesia	43	18	54
Costa Rica	59	16	9
Russia	61	16	2
Belgium	97	15	0
Morocco	56	15	14
Vietnam	28	15	48
United Kingdom	80	14	0
Kazakhstan	35	14	52
Mexico	77	14	5
United States	79	12	0
China	46	8	36
Average	54.6	29.6	33.9

NA = not available

Sources: U.S. Central Intelligence Agency. (2009). *CIA World Factbook.* Washington, DC: Author; Population Reference Bureau. (2009). *World Population Data Sheet.* Washington, DC: Author.

7.11 POVERTY IN THE UNITED STATES

Poverty was officially recognized as a key national problem during the 1960s. As seen in Figure 7.20, the poverty level in 1959 for all Americans was 22 percent, for Whites 19 percent, and for Blacks 55 percent—levels much higher than today. By 1965, the overall national rate had fallen to 17.3 percent. The War on Poverty, launched by the Johnson administration in 1965, produced many gains. Although the nation made a lot of progress, in particular in the 1960s toward reducing Black poverty, the decades since 1970 have shown ups and downs in this measure, generally tied to the economic cycle. For instance, in the latter half of the 1990s, the poverty rate dropped across all race categories as the economy boomed. The national poverty rate fell to a low of 11.3 percent in 2000, close to the all-time low of 11.1 percent in 1972, in the immediate aftermath of the War on Poverty. It has been fairly steady for the past decade, rising with the recession to 14.3 percent in 2009 (U.S. Census Bureau, 2010c).

In 2001, poverty was twice as high in the central cities (18.4 percent) as the suburbs (8.3 percent). The difference between central city and suburbs was greatest in the metropolitan areas of the Northeast and Midwest and less in those of the Sunbelt.

Examples of 2008 recessionary poverty rates for individual metropolitan areas, starting with the highest, are city: of Chicago, 20.6 percent; city of San Antonio, 16.0 percent;

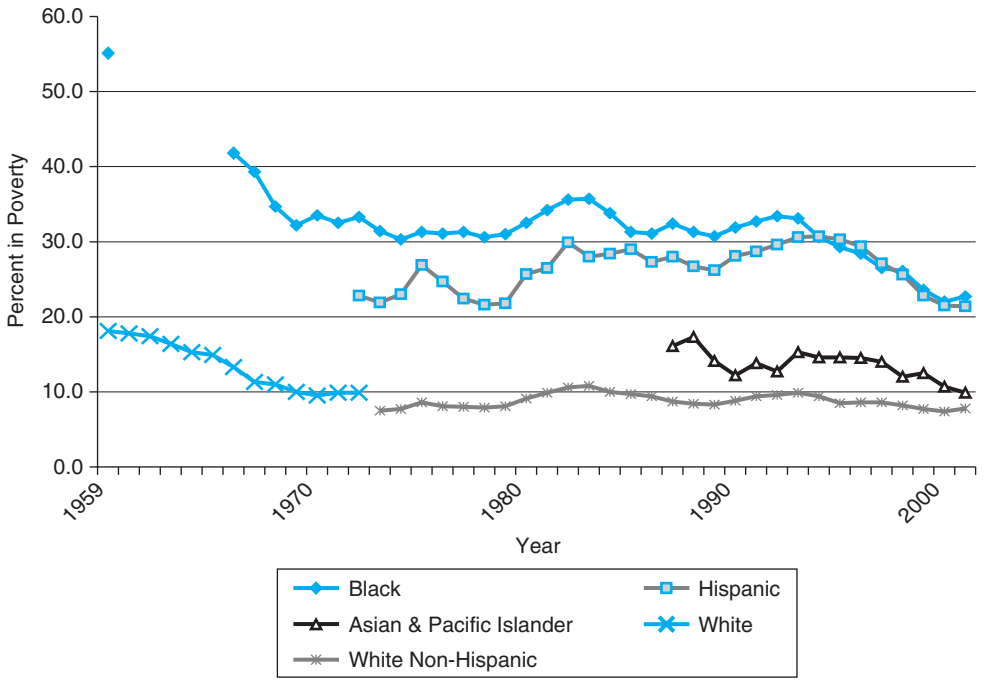


FIGURE 7.20 Changes in U.S. poverty levels, by ethnic group, 1959–2001.

Los Angeles–Riverside–Orange County, 14.0 percent; Miami, 13.8 percent; New York–Northern New Jersey–Long Island, 12.3 percent, and Chicago–Gary–Kenosha, 11.8 percent. During the mostly prosperous 1990s, poverty change in U.S. metropolitan areas was neutral; half of them increased and half of them decreased in poverty rate. Relative to a booming economy, central cities were not doing well in fighting poverty. The situation had been even worse in the 1980s, when the poverty rate rose 75 percent for central cities.

Although our focus is on urban geography, it is important that the poverty rate in 2000 was higher in nonmetropolitan areas than in metropolitan areas (Lichter & Crowley, 2002). Why is this the case? Away from larger cities, poverty tends to be located in small pockets, characterized by residents with very low education and job skills. Nonmetropolitan poverty is further associated with isolation, very poor schools, unsafe drinking water and other environmental conditions, weak public infrastructure, and racial discrimination. The effect of such poverty is seen in the list of states with the highest statewide poverty rates in 2000, being primarily states with large rural populations.

Another important perspective on poverty is the distinction between episodic poverty and chronic poverty. *Episodic poverty* is the result of a short-term or midterm condition, such as a divorce, temporary job loss from an economic recession, or family loss stemming from a natural disaster. In those conditions, a person can take short-term steps to exit poverty by correcting the condition. In *chronic poverty,* the person is often trapped in poverty by low education, lack of skills, disabilities, and persistent discrimination. People in that category are often referred to as the underclass, a topic that is taken up at the end of the chapter. For the chronically poor, poverty must be viewed as a long-term condition from which it is very difficult to exit.

7.12 EXTREME POVERTY: THE GHETTO AND THE UNDERCLASS

Returning to the United States, at the bottom of the poverty scale there are areas of *extreme poverty*. These are commonly zones that have 40 percent or more of their residents in poverty, contrasted with the recent overall national rates of 11 to 13 percent. The areas of extreme poverty in cities tend to be in or near ghetto areas (Greene, 1991; Jargowsky, 1996, 1997), but extreme poverty is not exclusive to the ghetto (Baud et al., 2008). The *underclass* refers to those people living in chronically extreme poverty and facing social barriers when they try to extract themselves from it.

The causation of the ghetto has been explained as deindustrialization, as well as cycles of entrapment related to lack of education and joblessness. Wilson (1987, 1996) explained a major cause of the ghetto as deindustrialization and accompanying middle-class flight to the suburbs. His studies were based on the city of Chicago. Here economic trends caused the central city to lose manufacturing jobs and gain service and white-collar jobs (Hudson, 2006; Peck & Theodore, 2001). Another example of this is Pittsburgh, which, starting in the 1920s and 1930s, replaced its former huge steel manufacturing core largely with service jobs. A primary reason was lack of level land near water transportation. In both cases, this meant that impoverished ghetto residents had a harder time finding jobs for which their usually low skills are suited. A concurrent trend is that middle-class households, both Whites and Blacks, are leaving the central city to seek improved living circumstances in the suburbs. The people left behind in the poor neighborhoods, according to Wilson (1987), lose their middle-class role models. All these trends together tend to trap the ghetto resident in the ghetto,

Poverty in Central American Cities

Urban poverty is on the increase in Central American metropolitan areas and cities. The rapid urbanization of Central America is contributing to this process. The entire region is anticipated to rise in urbanization (i.e., the percentage of the population in urban areas) by 20 percent from 1970 to 2010 (World Bank, 2002). Some nations are expected to increase even more rapidly over the 40 years—particularly El Salvador (projected to rise from 39 to 70 percent), Honduras (29 to 61 percent), and Costa Rica (39 to 64 percent). A study by the World Bank (2002) examined the problem of poverty in three rapidly growing cities in the region: Panama City, Panama; Tegucigalpa, Honduras; and San Salvador, El Salvador. Because of the rural-to-urban immigration and the natural population increase, the primate or capital cities of Central American nations are becoming outsized. *Outsized* refers to a metropolitan area's growth beyond the capacities of its natural environment to support it. In some respects, these cities are moving along the track of Mexico City, which has suffered from too much growth. Because the countries are smaller than Mexico, there are fewer competing cities, which adds to their growth potential. The three study cities are growing rapidly, and the number of poor households is expanding at twice the rate of well-off households (World Bank, 2002). The poor in these cities tend not to belong to the formal labor market, but rather are unemployed or work in the informal labor force—that is, in small concessions such as street vendors, car cleaners, and so on. Poverty in Central America is shown in Figure 7.21. Only a third of the poor belong to and are able to benefit from the social security systems.

Another set of problems relates to lack of infrastructure and city services. The cities usually lack potable water, sewers, and solid waste disposal service (Tarmann, 2002). The lack of drinking water harms public health. The government agencies providing the services often have faulty information systems, so they do not know who or where their poor customers are. As a result, a poor household might have to wait five years to be connected to water and other utilities (World Bank, 2002) and, meanwhile, be forced to scavenge for water, firewood, and other essentials.

Corruption might play a role, too. The land that is available to the poor is often inadequate and on the periphery, sometimes in steep locations like ravines or hillsides. As in Mexico City and other Latin American cities, the poor often construct their own homes here, initially using cheap materials, and then continue to improve them over a long period of time, even a generation, making use of better materials and construction. Sometimes this is a way out of poverty if their investment increases in value. However, since the poor often lack government documents for the land they occupy, land developers try to sell them false land titles. The poor can suffer financial losses as a result of such "pirate" land developers (Tarmann, 2002).

FIGURE 7.21 Poverty in downtown San Salvador, 2000. *Source*: Yuri Cortez/Agence France Presse/Getty Images.

FIGURE 7.22 Ghetto neighborhood in Chicago. *Source*: AP Wide World Photos.

without the money or educational ladder to escape. An area of Chicago's largely Black ghetto is seen in Figure 7.22.

Wilson's theory has been tested by other scholars (Greene, 1997; Massey & Denton, 1993; Strait, 2000, among others). Although as a whole it has held up fairly well under intense scrutiny, many disagree with parts of it. One criticism is that it does not take into account regional differences. For example, some poverty areas might be located in economically dying areas of a multicounty region and not be associated with a metropolitan area. Another is that the theory does not recognize the importance of the trend to outsourcing that has been affecting U.S. industry for more than a decade (Strait, 2000). Outsourcing might take away low-skilled jobs from ghetto residents.

The underclass was seen by Massey and Denton (1993) as increasingly trapped in the ghetto, without an obvious way out. "The deck is stacked against black socioeconomic progress, political empowerment, and full participation in the mainstream of American life" (Massey & Denton, 1993, p. 148). The trapping took place because the social aspects of segregation were so strong that they pressured young ghetto residents to not violate the ghetto culture by receiving too much education or by obtaining too high level of a job. Cultural evidence of this "inside" behavior has included speech patterns and use of distinctive language. The cycle perpetuating the ghetto consists of a strong ghetto culture, separation, isolation, and poverty (Massey & Denton, 1993).

In the 1990s and the early 21st century, there are some positive signs that the prospects of the underclass have somewhat improved. Economic status improved for low-income neighborhoods throughout the United States (Ellen & O'Regan, 2008). For neighborhoods with higher percentages of Black and poor residents, the prospects for later economic gain were higher (Ellen & O'Regan, 2008). The causes of this reversal include economic growth (throughout the 1990s); a reduction in crime levels; welfare reform of the Clinton administration, which pushed more responsibility to states; improved mortgage loans for poor neighborhoods; and shifts in federal housing policies, including the HOPE VI program, which demolished many large federal project buildings and replaced them with improved smaller ones, and the Low Income Housing Tax Credit (Ellen & O'Regan, 2008). In Chapter 11, Obama administration proposals for programs to build on these gains in the second decade of the 21st century are discussed.

Other scholars have added new dimensions to the study of extreme poverty. Jargowsky (1996) used extensive data to examine the characteristics of people who live in extreme poverty throughout the country. He found, for instance, that, although extreme-poverty neighborhoods were 50 percent Black, they were also 22 percent White, 14 percent Mexican, 6 percent Puerto Rican, and 8 percent other races. The industry distribution of workers in high-poverty areas did not differ from city neighborhoods outside these areas (Jargowsky, 1996), although unemployment was high. Many ghetto residents held jobs, attended school, and were not criminals or drug addicts. However, the one characteristic that was present throughout the extreme-poverty areas was mother-headed households, with the father absent (Jargowsky, 1996).

Greene (1991) looked at the relationship between extreme poverty and population and poverty growth. As seen in Figure 7.23, the group of neighborhoods in New York City with the most extreme poverty had declining population and increasing poverty (labeled B on the chart and map). The main concentrations of these areas were in the ghettos of the Bronx and Brooklyn. These areas corresponded to Wilson's theory of greater poverty amidst White flight. It is interesting that small frequencies of other types of extreme-poverty neighborhood

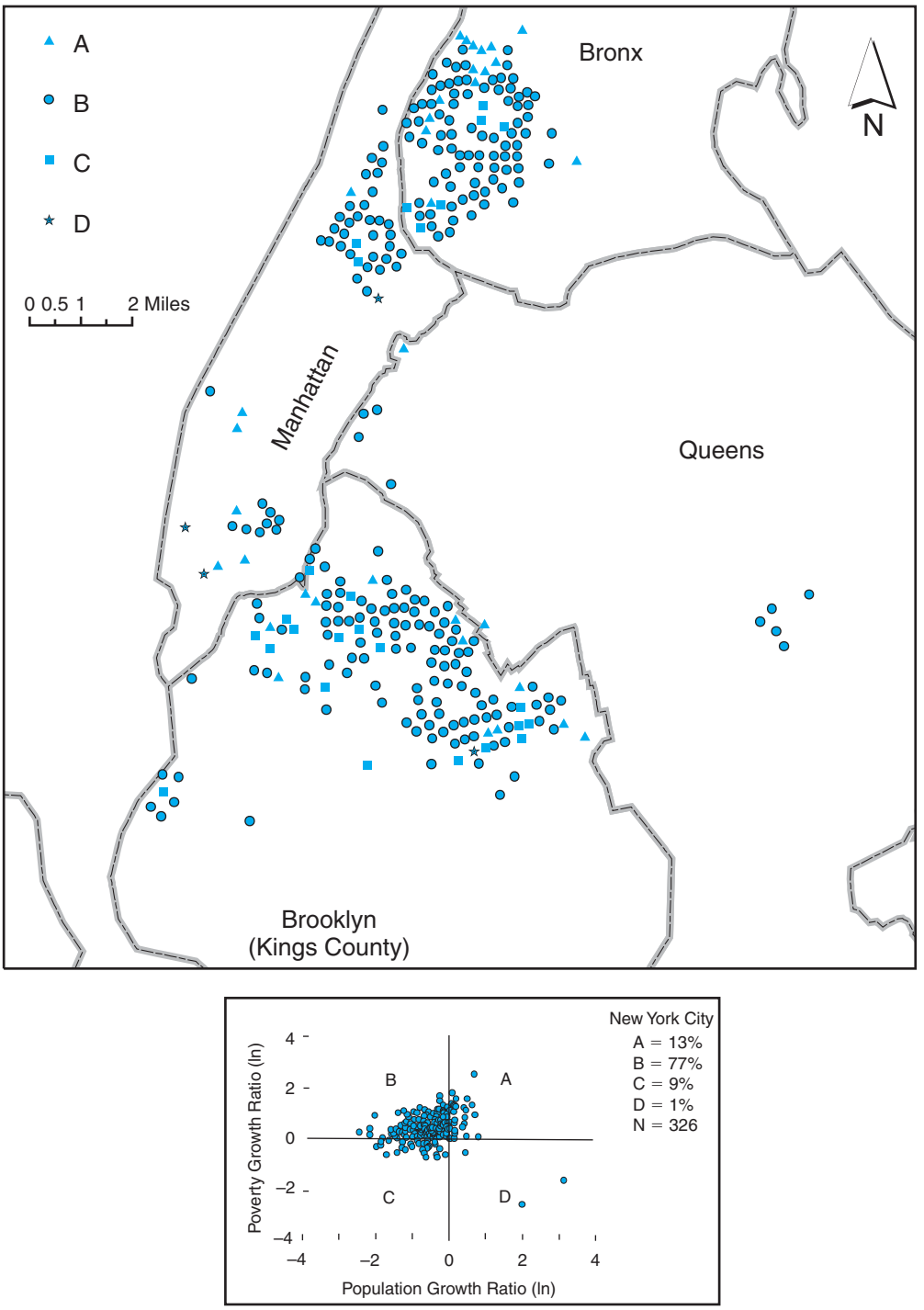


FIGURE 7.23 Extreme-poverty neighborhoods in New York City. *Source*: Greene, Richard P. 1991. "Poverty Area Diffusion: The Depopulation Hypothesis Examined." URBAN GEOGRAPHY 12(6): 526–541. © Bellwether Publishing, Ltd. Reprinted by permission. Figure 4. P. 536.

groups (A, C, and D in Figure 7.23) were scattered near the edges of the ghetto areas. In repeating this analysis for Los Angeles, there was less support for the dominance of group B than Wilson had expected. Wilson had studied Chicago and might have missed other patterns in newer Sunbelt cities.

Although some gains have been made, the underclass continues into the 21st century. It is a social group that experiences great suffering and often has reduced motivation to try to break out of the cycle.

7.13 ANOTHER TYPE OF POVERTY AREA: COLONIAS ALONG THE MEXICAN BORDER

Colonias are unincorporated places on the U.S. side of the United States–Mexico border that are poor, lack basic utilities, and have serious health problems. It is estimated that about 400,000 Texans live in colonias (Giusti, 2008) and there are tens of thousands of additional colonia residents in New Mexico and Arizona. The majority of colonia residents have

U.S. citizenship, yet their primary language is Spanish, which restricts their educational advance. An estimated 15 percent are not legal residents of the United States (Texas Natural Resource Conversation Commission, 1999). There are many first-generation families who have invested their life savings in homes and businesses in colonias. The housing structures are often crude and built by the owners in stages with a patchwork of materials that include bricks, plywood, and cinder blocks (Pepin, 1998; Texas Secretary of State, 2002). Housing in a Texas colonia is seen in Figure 7.24. The word *colonia* in Mexico has a different meaning—it refers to a government-defined neighborhood in a city, which could be at any income level. In Mexico, the concept more analogous to the meaning of a U.S. colonia is a squatter settlement, located mostly at the periphery of cities. Squatters are immigrants who arrive generally with limited means and initially construct makeshift housing, often claiming or "squatting" on the land (Ward, 1998a).

The level of income in colonias is very low; in one Texas study, the median family income was only $9,000 per year (KLRU and PBS Online, 2002). About 43 percent of Texas colonia residents are classified as living in poverty (Ward, 1998b). The Texas counties with the highest colonia prevalence are among the poorest in the United States.

The first colonias appeared in the 1950s in Texas. Developers saw opportunities to purchase lots outside city limits, often along floodplains. For example, the distribution of colonias on the outskirts of El Paso, Texas, is seen in Figure 7.25. The lots could be legally subdivided, and there were no regulations requiring developers to put in standard utilities. Developers for many years benefited by the use of *contracts for deed,* a technique of selling land where the buyer puts only a small amount down and has low monthly payments. However, the buyer does not receive the title until the final payment has been made. This practice was

FIGURE 7.24 Housing in a Texas colonia near the Mexican border. *Source*: Pepin, M. (1998). *Texas Colonias: An Environmental Justice Case Study.* Available at http://itc.ollusa.edu/faculty/pepim/philosophy/cur/colonias.htm

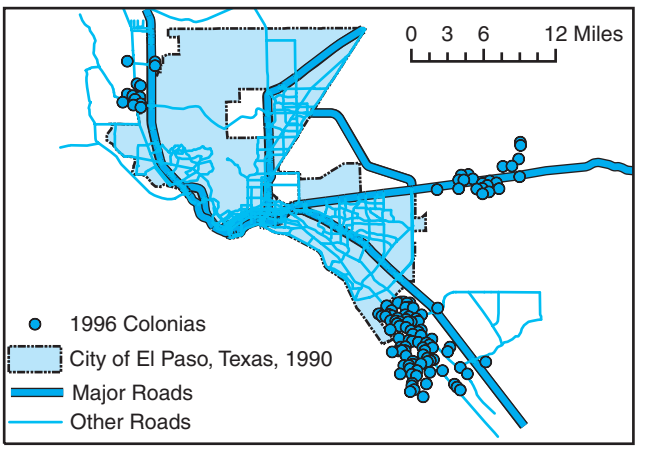


FIGURE 7.25 Colonias in El Paso, 1996. *Source*: Adapted from Border Colonia Geography Online. State of Texas, Office of the Attorney General, www.oag.state.tx.us.

restrained by the 1995 Colonias Fair Land Sales Act in Texas, but difficulties with this type of financing remain (Texas Secretary of State, 2002). Because the buyer under a contract for deed does not own the property until the last payment is made, he or she cannot use the property as collateral for a loan, making financial institutions less likely to lend to colonia residents; also, the risk of foreclosure is higher in these areas.

Their inadequate utilities and infrastructure are the most unfortunate aspects of colonias. In 1990, it was estimated that colonias in Hidalgo, Cameron, and El Paso Counties had utilities and services provided to the home in the following percentages: potable water connections at 75 to 95 percent, heating at 50 to 60 percent, sewage at 0 to 5 percent, and trash at 0 percent (KLRU and PBS Online, 2002; Pepin, 1998).This meant that households with deficits had to go to outside providers to obtain these services. A 1990 General Accounting Office report indicated that 59.7 percent of colonias had access to a water system, but only 0.4 percent had access to a sewer system (Chapa & Eaton, 1997). This means that sewage and wastewater are released to contaminate the environment. It is not surprising that there is poor health in the colonias, including high rates of tuberculosis, hepatitis A, salmonellosis, dysentery, cholera, and giardiasis (Federal Reserve Bank of Dallas, 2004; U.S. Environmental Protection Agency, 2004). The poor drainage and threat of flooding in the region add to the public health problems.

Given all these problems, why have colonias been developed and persisted? The driving forces have been the need for housing and the desire for an improved standard of living among Mexican immigrants and poor Mexican-American residents (Garcia, 2006). They lack assets to purchase housing and so seek something affordable, even at this low level. The colonias appear to have a more traditional family pattern than does Texas as a whole (Pepin, 1998). The problems for this form of poverty primarily involve environmental damage and degraded health conditions. The colonias were not the result of large-scale economic-based immigration and resistance to it, as with the ghetto; rather, they stem from the need for very inexpensive housing (Garcia, 2006). Colonias form a contrast that broadens the notion of U.S. poverty and points to a common thread of very low income.

Summary

This chapter covered the significant urban geography topics of race, ethnicity, gender, and poverty. The cities in every society have these elements. Cities are built up partly through migration, which often is from other nations and frequently brings in new racial and ethnic groups. The ethnic mix contributes to the variety and appeal of city life and urbanism, but also provides the basis for potential conflicts. Cities have geographic patterns of ethnicity that often change over time as central-city communities change and expand outward to suburbs, and beyond to exurbs, and as successive redistributions and migration changes occur. The chapter looked at the immigration, settlement, and further dispersion of the major ethnic groups of Blacks and Latinos and Hispanics.

Gender is an important aspect of urban geography that has received increased attention in recent years. Gender includes the topics of gender inequality, gender and public space, the work and home patterns of women and men in the city, migratory transitions in gender identities in China, gendered identities, and the related topic of sexuality. Although some feminist researchers have criticized GIS, others have demonstrated ways that it can better support the understanding of human emotions, personal values, and behavior.

Poverty can be measured in a variety of ways, one of which is based on the ability to afford basic baskets of goods. In the United States, poverty dropped following the War on Poverty in the 1960s, but in recent decades, it appears to have stabilized and has shown some increase in the Great Recession of 2007–2009. The extreme poverty that is present in the ghetto and that has led to the development of an underclass seems to have been alleviated somewhat. The poverty in colonias along the Mexican border is distinctive in its deep and chronic environmental and health problems. Overall, the poverty problem is a long-term policy issue for governments and international organizations.

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Exercise

Exercise Description

Employing a set of statistical procedures known as centrographic methods.

Specifically, in this project we will compute a year 2000 mean center and standard radius (also known as standard distance) for three groups—Blacks, Hispanics, and Asians—in the Dallas metropolitan area. The standard radius is a spatial measure of dispersion; a large value indicates wide dispersion, and a small value indicates concentration. By computing a standard radius for each group, we can determine which group is more spatially concentrated.

Background Information

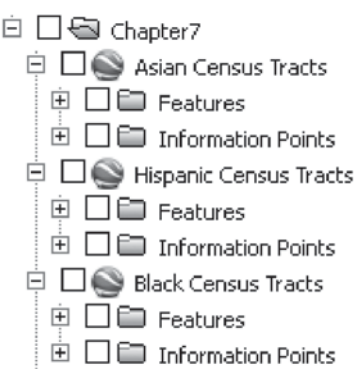
Centrographic Methods: A frequently asked question in urban geography is this: How segregated are groups within cities? To answer this question, nonspatial measures such as the well-known index of dissimilarity have been applied. Although these measures provide a useful statistic for understanding the amount a group would have to be redistributed to be fully integrated, they lack the cartographic element associated with centrographic methods. Centrographic methods can summarize large quantities of spatial data and can be simultaneously represented on a map. The specific centrographic statistic used in this exercise is known as a standard deviational ellipse.

Google Earth Procedures

1. Launch the Chapter 7 Google Earth KMZ file by double-clicking it:

   EUC_Ex7.kmz

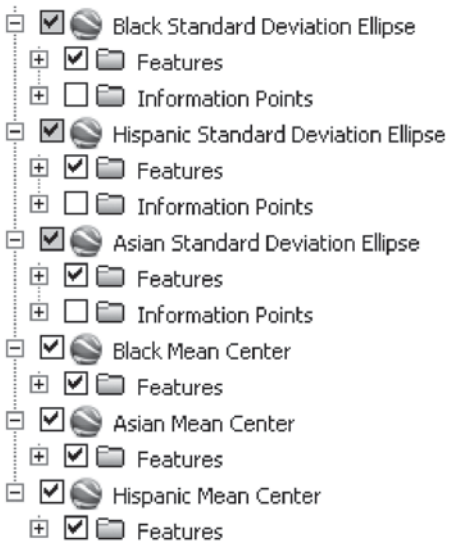
2. Expand Chapter 7, turn on each Census Tract layer, and turn off all Information Points.

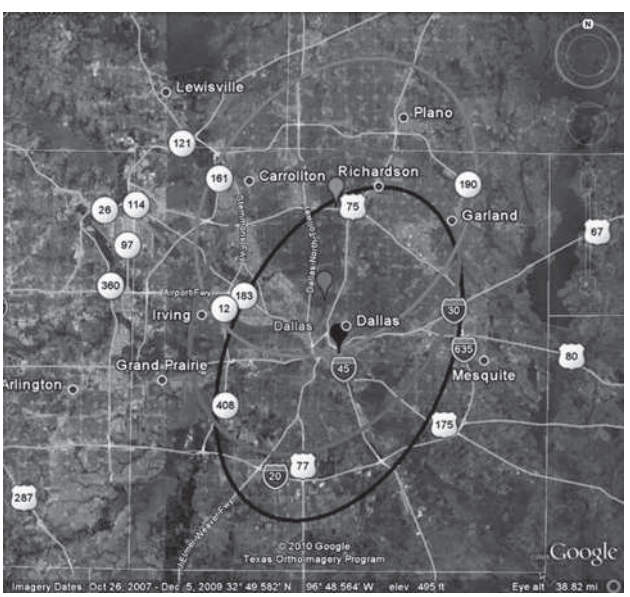


3. Toggle off the Asian and Black Census Tracts, and you will be displaying the Hispanic Census Tracts. Toggle off the Hispanic and turn on the Black Census Tracts, and you will be displaying the tracts with

Black concentrations. Practice toggling on and off these three groups—you may have to turn off the Information Points each time.

4. Which group is most concentrated north of Dallas? Which group is most concentrated south of Dallas?
5. Turn off all three Census Tract layers, and let's examine the bottom six layers.





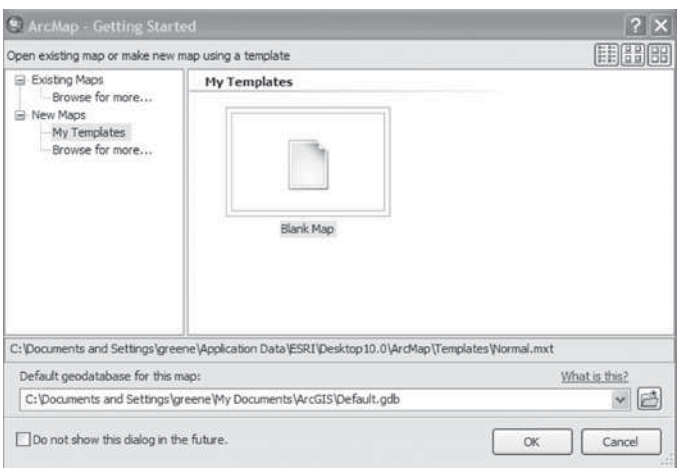
The balloon symbols represent the mean center of each group, while the ellipses represent the standard deviational ellipsis of each group.

6. Drag the Street View icon onto the map, explore the Asian ellipse area. Read the "Analyzing an Urban Issue" section in this chapter.
7. Why is it more difficult to find a representative Asian landscape in Dallas than it was in Los Angeles using Street View?
8. What is the distance between the Asian and Black mean centers? Use the ruler tool in Google Earth. Using Street View, explore areas around the Asian and Black mean centers, and the area in between. Do you see transitional differences in the built environment as you move from one center to the other? If so, what are they?
9. What is the distance between the Asian and Hispanic mean centers? Measure the length and width of the Asian and Hispanic ellipses. How are they different? Explain what accounts for the differences.

Google Earth Short Essay: In your essay, discuss the differences in the locations of the distributions of Asians, Blacks, and Hispanics in the Dallas area. Include a discussion of the difficulty of finding landscape evidence of each of these groups, compared to Los Angeles in the previous chapter. For each ethnic/racial group, compare the actual census tract distribution with the ellipse. Start by turning on the Hispanic Census Tract distribution. Next, turn on both the Hispanic Features and the Hispanic Standard Deviation Ellipse, but turn off all the other Places layers. For which urban planning purposes would the census tract distribution be more useful? For which urban planning purposes would the ellipse be more useful? Why?

ArcGIS 10 Version

1. Start ArcMap. Under New Maps, click My Templates, and then double-click the Blank Map template.

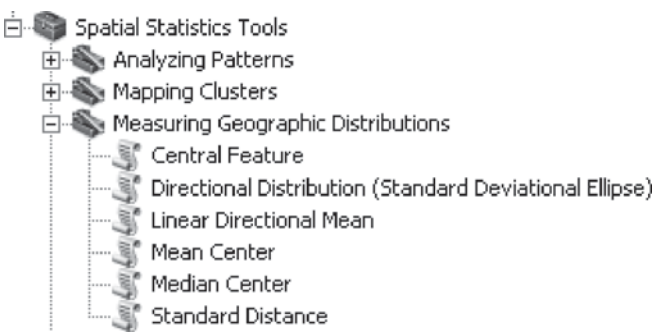


2. Click Add Data, and navigate to the exercise data folder.

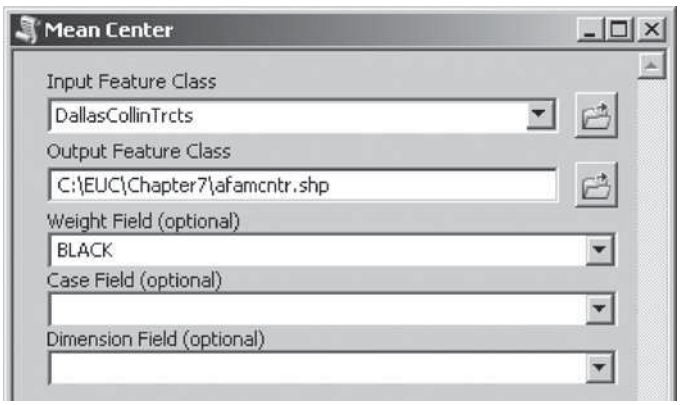
Note: If you do not see the folder where you placed the exercise data, you will need to make a new connection to the root directory that holds the data.

3. Add DallasCollinTrcts.shp and DwnTwnDallas.shp from the Chapter 7 folder. You can add the two layers at once by clicking one of the file names, clicking the other one while holding down the Ctrl key on the keyboard, and then clicking Add.
4. Right-click the layer name DallasCollinTrcts, and click Open Attribute Table.

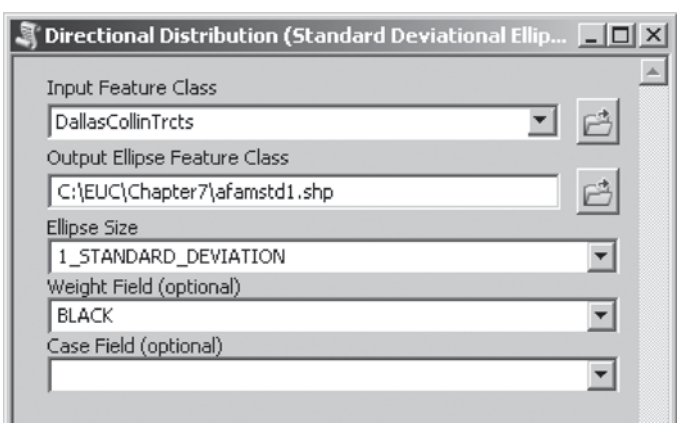
   Note that the table has year 2000 information for the total population, White population, Black population, Asian population, and Hispanic population. We next compute the mean centers for the Black, Asian, and Hispanic populations.
5. Close the table, and click the ArcToolBox button at the top (red button).
6. Under Spatial Statistics Tools and Measuring Geographic Distributions, double-click Mean Center.



7. Fill in the Mean Center window by specifying an input file (DallasCollinTrcts.shp), output file (afamcntr.shp), and weight field (Black). The path names might be different on your machine, and the output file is a new file to be created.



8. Click OK, and the program will display a processing box. Click Close when completed.
9. Repeat the calculation of a mean center for the Asian and Hispanic populations.
10. Now compute a standard deviational ellipse for each population. Under Spatial Statistics Tools and Measuring Geographic Distributions, double-click Directional Distribution (Standard Deviational Ellipse).
11. Fill in the Standard Deviational Ellipse window by specifying an input file (DallasCollinTrcts.shp), output file (afamstd1.shp), and weight field (Black).



12. Choose 1 Standard Deviation as the ellipse size, and click OK. A progress bar will appear at the bottom of the ArcMap window as the standard deviational ellipse is processed.
13. Repeat the calculation of a standard deviational ellipse for the Asian and Hispanic populations.
14. If you right-click and open the attributes of the standard deviational ellipse layers, you can observe the coordinates for each group's mean center and the standard distance for X and Y, as well as a rotation factor.

Black Population

afamstd1

FID	Shape *	Id	CenterX	CenterY	XStdDist	YStdDist	Rotation
0	Polygon	0	-72554.7939	1078332.85	12595.4015	20462.3732	24.470407

Asian Population

asianstd1

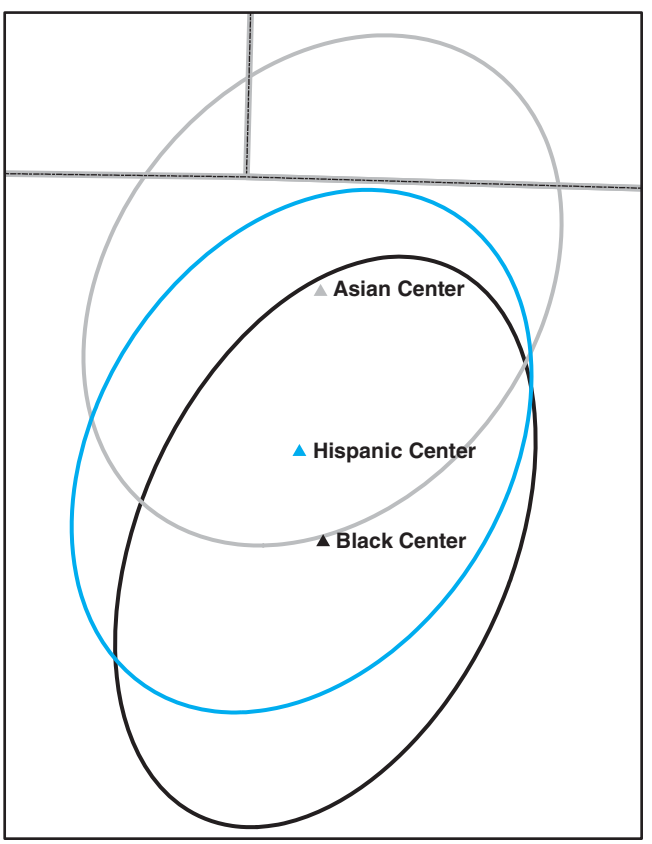
FID	Shape *	Id	CenterX	CenterY	XStdDist	YStdDist	Rotation
0	Polygon	0	-72749.6056	1095385.4	14308.2145	18893.6017	38.085518

Hispanic Population

hispstd1

FID	Shape *	Id	CenterX	CenterY	XStdDist	YStdDist	Rotation
0	Polygon	0	-74168.9626	1084487.98	13816.2988	19129.5469	33.03844

15. You can make the polygon symbols for the standard deviational ellipse layers hollow so that you can see all three layers together. Click the Symbol box below afamstd1, and in the Symbol Selector dialog box, click the Hollow symbol, change Outline Width to 2, change Outline Color, and click OK. Repeat this step for asianstd1 and hispstd1.



16. Select Layout View on the View menu to compose a map with the mean centers and ellipses. Go to the exercise folder and add Downtown as a dark polygon and the County layer as hollow.

ArcGIS Short Essay: In your essay, review the chapter's "Analyzing an Urban Issue" section. What is the distance between the three mean centers in Dallas, and what does this tell us about the general location of these three groups in Dallas? Which group is more concentrated? Why might this difference be important for urban planners? Do you see any political or social implications of the centrographic results? What are some of the strengths and weaknesses of centrographic methods?

Log in to www.mygeoscienceplace.com for ArcGIS Exercise data files, Google Earth™ Exercise kmz files, RSS feeds, flashcards, web links, and self-study quizzes to enhance your study of race, ethnicity, gender, and poverty.

CHAPTER

8 Industrial Location and Cities

Cities are places of both production and consumption. During the Industrial Revolution, cities became the main locus of manufacturing activity and grew rapidly as a result. Although the modern-day city still accommodates manufacturing (see Figure 8.1), cities have become more diversified in the range of industrial activities they perform. Nevertheless, some cities (e.g., Davenport, Iowa) continue to specialize in manufacturing, whereas others (e.g., New York City) have become prominent centers of producer services, and still others (e.g., Las Vegas) have become more specialized in consumer services. This chapter focuses on the role of industry in cities. Cities are important for industry not only because they facilitate the production process by supplying a rich and diverse labor force, but also because they drive a consumption process triggered by a dense demand for products and services.

This chapter examines the location of industry both across cities (interurban) and within cities (intraurban). It presents these location concerns in their historical context, as geographers have introduced a number of paradigms over time for analyzing industries in cities. The chapter reviews the recent resurgence of activity among urban scholars on the topic of industry and cities, most notably on the location of manufacturing activity, services, and consumption. However, it begins with the formal theorizing of manufacturing location that can be traced back to Alfred Weber (1929), a pioneer in this endeavor. The urban geography of services is examined with mention of its roots in central place theory, a topic already discussed in Chapter 4. It reviews the rapid growth of the service industry and the subsequent explosion in subcategories within this industry. It considers the full extent of industry, which is a broad term that includes all economic activities, such as manufacturing, retail, wholesale, services, finance, and government.

The chapter focuses on urban industrial topics, mostly in the context of the United States, but with some discussion of industrial issues in Mexico, particularly the *maquiladora* industry in the twin cities along the United States–Mexico border. Concepts of globalization and comparative advantage must be considered in explanations for differences in the industrial composition of cities that are adjacent to each other, but that are nonetheless divided by national borders. An example of consumption exchanges between Mexican and U.S. cities is also presented where each city depends on the other for local business.

Also included here is a contemporary analysis of interurban patterns of industry that considers the transformation of cities from an emphasis on production to increasing shares of service and white-collar employment. The chapter reviews recent studies on cities that have attracted a disproportionate share of high-tech industry and other studies that look at the factors that continue to add to their growth. It reviews the geography of retail services and a new consumer-city hypothesis, which emphasizes the importance of consumption over production for predicting future urban growth and development. The final section considers the geography of producer services.

8.1 INDUSTRY CLASSIFICATION AND LOCATION CONCEPTS AND PROCESSES

This section presents basic definitions and concepts for industrial location within and across cities. These definitions serve as foundations for understanding the follow-up sections on processes and case studies. Urban economies are complex and are made up of activities that are not always easy to classify and/or describe.

FIGURE 8.1 Los Angeles factory.

To discuss the relationships between cities and industry, we adopt a classification of industry types used by economic geographers:

1. ***Primary Activities:*** Agriculture, mining, fishing.
2. ***Secondary Activities:*** Manufacturing and construction.
3. ***Tertiary Activities:*** Retailing and services.
4. ***Quaternary Activities:*** Information services and data processing.

Primary economic activities include those activities where workers are directly engaged with raw products such as agriculture, fishing, and mining. Secondary economic activities include manufacturing industries or those industries where workers are involved in making or processing products. The tertiary economic sector consists of activities where workers are involved in providing services, both to producers and to consumers. Some have modified this classification of economic activities to include a quaternary sector made up of professionals engaged in the production and processing of information or knowledge-based activities. With growing diversity in activity types in the economy, it is important to recognize more specialized categories of economic activity (see Figure 8.2). Note, for instance, the declining proportion of U.S. gross domestic product (GDP) produced in manufacturing (nondurable and durable goods) from 1948 to 2008 and the rising proportion of GDP produced in services over the same time period, especially in education, health care, and social assistance, which is matched by an equal amount of GDP share growth in GDP by professional and business services.

To reflect ongoing economic transformations in the global economy, the U.S. Census Bureau replaced its long-established Standard Industrial Classification (SIC) with the North American Industry Classification System (NAICS), starting with its 1997 Economic Census (U.S. Census Bureau, 2000). The SIC system was first developed in the 1930s when many large U.S. cities had a strong manufacturing base. The NAICS recognizes industry categories that are more commonplace in today's economy, including an explosion of service categories and new terms to capture activities in the information economy (see Table 8.1). Overall, the 2007 NAICS recognizes 1,175 industries, many of which were not previously identified separately by the SIC system (U.S. Census

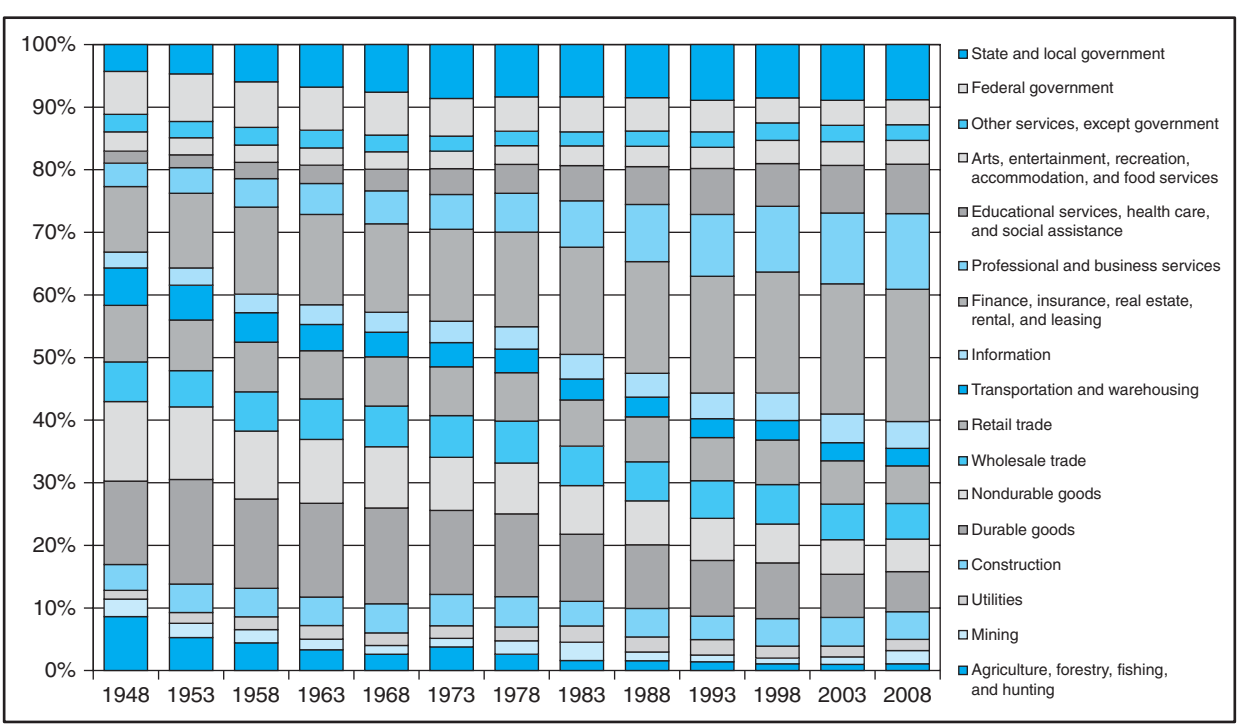


FIGURE 8.2 Gross domestic product: Percentage of total by sector, 1948–2008. *Source*: Bureau of Economic Analysis, Industry Economic Accounts. Author.

TABLE 8.1 NAICS Industries: Selected Examples

- Semiconductor machinery manufacturing
- Fiber-optic cable transmission line construction
- Computer software training
- Convenience food stores
- Gasoline stations with convenience food
- Warehouse clubs
- Food/health supplement stores
- Pet supply stores
- Cable television networks
- Satellite communications equipment manufacturing
- Paging services
- Cellular and other wireless communications
- Telecommunication resellers
- Credit card issuing
- Temporary help services
- Telemarketing bureaus
- Hazardous waste services
- HMO medical centers
- Continuing care retirement communities
- Casino hotels
- Riverboat casinos
- Bed and breakfast inns
- Limited service family restaurants
- Automotive oil change and lubrication shops
- Weight-reducing centers, nonmedical centers

Source: U.S. Census Bureau. (2010a). North American Industry Classification Systems (NAICS).

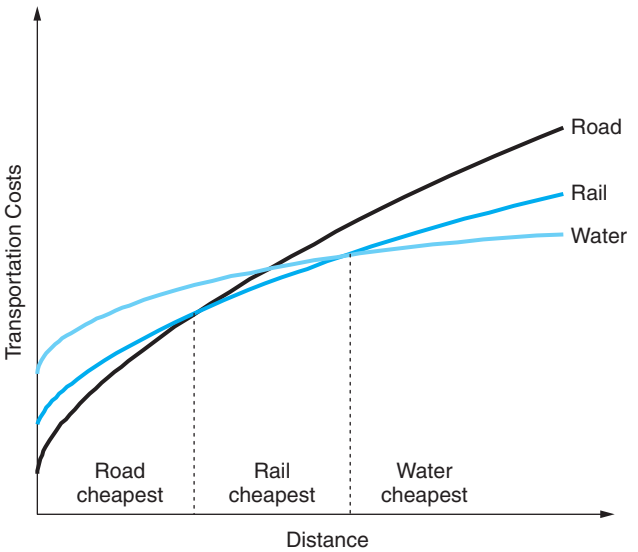


FIGURE 8.3 Transportation costs and distance. *Source*: Cadwallader, Martin. 1996. URBAN GEOGRAPHY: AN ANALYTICAL APPROACH,1st, © 1996. Printed and Electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, New Jersey. Fig. 7.2. P. 156.

Bureau, 2010a). Not only does the NAICS include current and appropriate concepts and definitions for the classification of industry, but also it makes the U.S. data more comparable to those of its neighboring countries of Canada and Mexico. Thus, the industrial compositions of a border city such as El Paso, Texas, and its Mexican counterpart Ciudad Juarez can be more easily compared.

8.2 MANUFACTURING LOCATION THEORY AND AGGLOMERATION

We begin with manufacturing because many cities, especially older cities, grew as a result of their reliance on this industry type. This section reviews two important theories with respect to manufacturing location. The first is known as least-cost theory, and the second is referred to as economic-base theory.

8.2.1 Least-Cost Theory

Alfred Weber (1929), a German economist, was the first to develop a general theory of manufacturing location. He was also the younger brother of the well-known sociologist Max Weber (Stutz & Warf, 2005). Weber explained the location of industry in terms of firms seeking a minimum cost location. The two principal costs isolated in Weber's model were labor costs and transport costs. Between these, Weber regarded transport costs as the more important factor because they increase with distance, although at a decreasing rate (see Figure 8.3). The initial loading and unloading costs at the origin and destination are referred to as fixed costs, and the distance charges are often set by zone, resulting in a stepping-stone, variable cost structure. In addition, the distance that a good is to be shipped often dictates the mode of transportation. The general rule is that water is best for long hauls, rail for intermediate hauls, and truck for short hauls.

These simple transportation cost principles allowed Weber to simulate a variety of location outcomes for manufacturing activity based on a number of different contexts. The following two examples will help illuminate Weber's approach. In the first, Weber considered the influence of transport costs on the location of a plant that exists in the context of a single market such as a city and a single input or material resource (see Figure 8.4). The firm wishes to build a plant to manufacture a product that

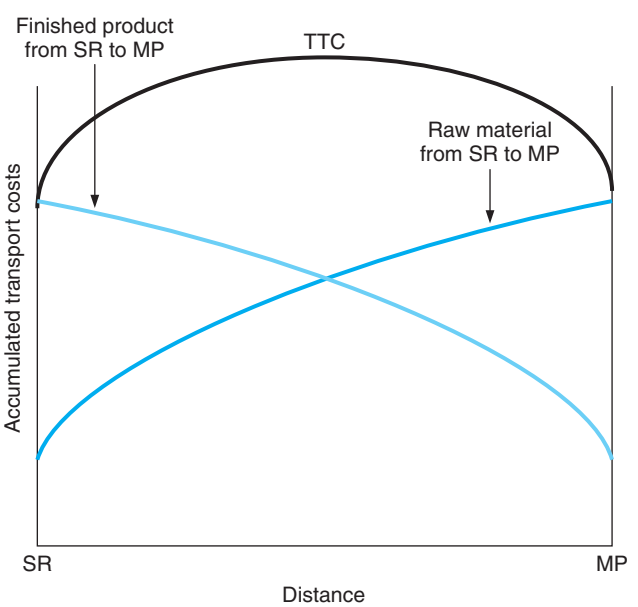


FIGURE 8.4 Transport costs versus distance: Single market and single raw input or raw material resource. *Source*: Yeates, Maurice. 1990. THE NORTH AMERICAN CITY (Fourth Edition). New York: Harper and Row Publishers. Reprinted by permission of the author. Figure 3.9. P. 82.

requires one raw material input from one source region (SR) and to sell its output in one marketplace (MP). In this situation, there are two possible least-cost locations—SR and MP. Any site in between incurs additional terminal costs (loading and unloading), as well as two short hauls, which cost more per unit of distance than does one long haul. TTC represents the total transportation cost of shipments. A second example shows, however, that it is likely that shipping the finished product from the source region is more costly than shipping raw resources. In that case, the plant will typically locate at the marketplace or city to avoid the high cost of shipping finished products (see Figure 8.5). Thus, in the second graph, the transport costs are lower at the marketplace, as indicated by the dotted line intersecting the vertical cost bars. Weber's original work considers many more scenarios, each isolating an aspect of the manufacturing location decision process.

One weakness of Weber's model when applied to today's U.S. manufacturing landscape is the emphasis on transportation costs, which have been shown to be of declining significance (Webber, 1984, p. 83). For instance, since the time of Weber's work, manufacturing in the United States has shifted away from heavy manufacturing toward light manufacturing, which requires less bulk on the input side, so there is less bulk when transporting the final finished goods as well. Figure 8.6 shows light manufacturing in Mexico City. In addition, many newer methods exist for shipping goods, including air freight and growing containerization for sea transport. Nevertheless, industrial geographers consider Weber's approach to be a good starting point for understanding the location of industries.

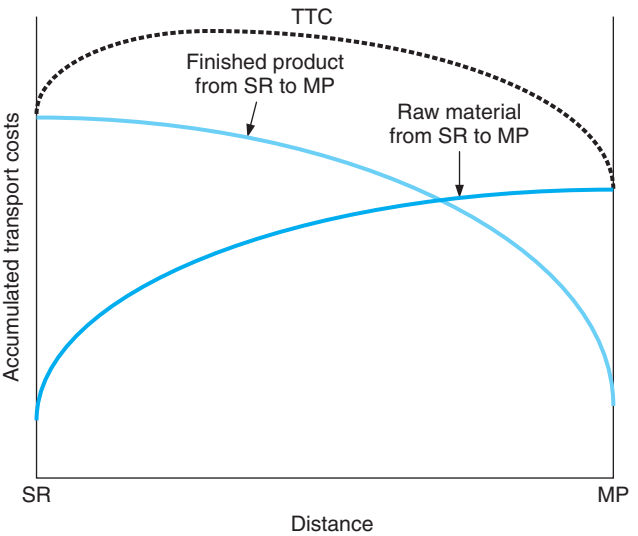


FIGURE 8.5 Transport costs versus distance: Cost differences for shipping finished goods. *Source*: Yeates, Maurice. 1990. THE NORTH AMERICAN CITY (Fourth Edition). New York: Harper and Row Publishers. Reprinted by permission of the author. Figure 3.10. P. 83.

8.2.2 Economic-Base Theory

The economic-base approach rose to prominence in the late 1930s after the publication of *Principles of Urban Real Estate* by Weimer and Hoyt (1939). The approach distinguished two types of employment, *primary* being industrial employment

FIGURE 8.6 Light manufacturing in Mexico City.

and *ancillary* representing service employment. Economic-base theory held that the foundation of a city and its ability to grow depended on manufacturing employment because it produced sales outside the community, referred to as exports. As a consequence of a growing industrial base, a city could expect growth in ancillary employment because revenue returning from export sales could support more services. Cleveland, Ohio, is a good example, where great transport access to Lake Erie by way of the Cuyahoga River facilitated growth and development in both its manufacturing base and its service base (see Figure 8.7). Employment related to the production of goods and services produced for export outside the community was referred to as basic, whereas employment related to sales within the local community was referred to as nonbasic. Economists at the time attributed urban growth to the basic portion of total employment, whereas ancillary services played only a supporting role.

In the 1940s and 1950s, urban practitioners adopted many of the ideas from economic-base theory for economic development. It followed from economic-base theory that urban growth would proceed fastest if a city concentrated on increasing its basic employment; in other words, one did not need to be too concerned about increasing nonbasic employment, as that would follow naturally. A basic/nonbasic ratio was developed to determine the proportion of service-related jobs that could be expected as a result of growing the manufacturing sector:

BA/NBA

where BA is basic activity employment and NBA is nonbasic activity employment. If a city determined that its ratio was 1:4, for instance, that would mean that for every person involved in a basic activity, there would be four persons engaged in a nonbasic activity. Once derived, the ratio could be assumed to be static, and it was not uncommon to use it as a predictor or what has become known as a multiplier effect. For instance, a 1:4 ratio might be used to suggest that an additional increase of 100 basic jobs would result in 400 new nonbasic jobs, for a total of 500 new jobs.

The economic-base approach is not as simple as it might first seem. Perhaps the most problematic aspect of the approach is determining how activities get classified as basic or nonbasic. Consider, for instance, the services provided by a medical doctor. At first, it might seem appropriate to classify them as nonbasic, but perhaps on later review, it is learned that some doctors in the community are attracting patients beyond the city limits. That raises an additional problem of where to draw the boundary to differentiate sales generated inside versus outside the community. These are all methodological issues that need to be addressed prior to applying the economic-base approach. Nevertheless, the approach is still widely used, and many variations have been developed, especially in the area of calculating multiplier effects (Hinojosa & Pigozzi, 1988; Mulligan & Kim, 1991). Markusen and Schrock (2009) critique the traditional economic-base approach and demonstrate that nonbasic goods, or what they designate as consumption-base goods, can also be a source of regional job growth. In particular, their study

FIGURE 8.7 Cleveland, Ohio: Access to water transport.

looked at the role of arts, entertainment, and health care and found their local consumption to have huge dividends for regional growth. Today, the economic-base approach continues to be widely used and applied among local economic development practitioners.

8.2.3 Agglomeration Economies

Agglomeration economies are another important topic in considering the location of manufacturing activity. Economic geographers refer to *agglomeration economies* as those savings in production costs that occur when firms and workers locate near one another (see Figure 8.8). Weber (1929) also considered agglomeration as a factor of location. Webber (1984, p. 78) defined three specific agglomeration economies. The first is the cost savings due to scale, such as the rise of businesses providing services to other firms. If there are many nearby clients being served, the firm providing services can achieve economies of scale, such as serving more client firms with daily visits by a service specialist. A second is information, as communication is enhanced by firms locating near each other. The third is social fixed capital or societal infrastructure, which would include railroads, highways, schools, shopping centers, and banks. All of them reduce production costs, including associated services.

Agglomeration continues to be explored by contemporary urban scholars. Cervero (2001) considered another agglomeration issue—the shape of a metropolis. He contended that the shape of a city carries significant costs and benefits for agglomeration economies. He empirically examined the relationships between labor productivity and certain indicators of urban form. Kenworthy and Laube (1999) found that gross regional product per capita was generally higher in cities that were less dependent on automobiles, i.e., in denser cities. Similarly, Cervero (2001) contended that large cities that are compact, have good accessibility, and are endowed with efficient transport technology are among the most productive of all urban settlements. Agglomeration economies were cited as a cause of the strong relationship between employment densities and productivity levels.

Agglomeration economies continue to be a topic of much research. Rigby and Essletzbichler (2002) recently examined the impact of agglomeration economies on industry productivity across U.S. metropolitan areas by examining plant-level data as opposed to aggregate data, which previous studies have relied on. They showed that many establishment and city-specific factors influence labor productivity across cities. Mota and Castro (2004) studied the injection mould industry cluster at Marinha Grande in Portugal and found that firms there profited immensely from the emergence of relationships between nearby firms.

Rantisi (2002) showed that New York City's Garment District—or Fashion Center, in today's parlance—benefits significantly from agglomeration economies (see Figure 8.9). The Fashion Center is bounded by 40th Street to the north, 34th Street to the south, Fifth Avenue to the east, and Ninth Avenue to the west. Seventy-five percent of Manhattan's apparel industry is located within this four- by six-block area. Two-thirds of

FIGURE 8.8 Oracle headquarters in Silicon Valley, with other tech company facilities in background.
Source: Corbis/Bettmann.

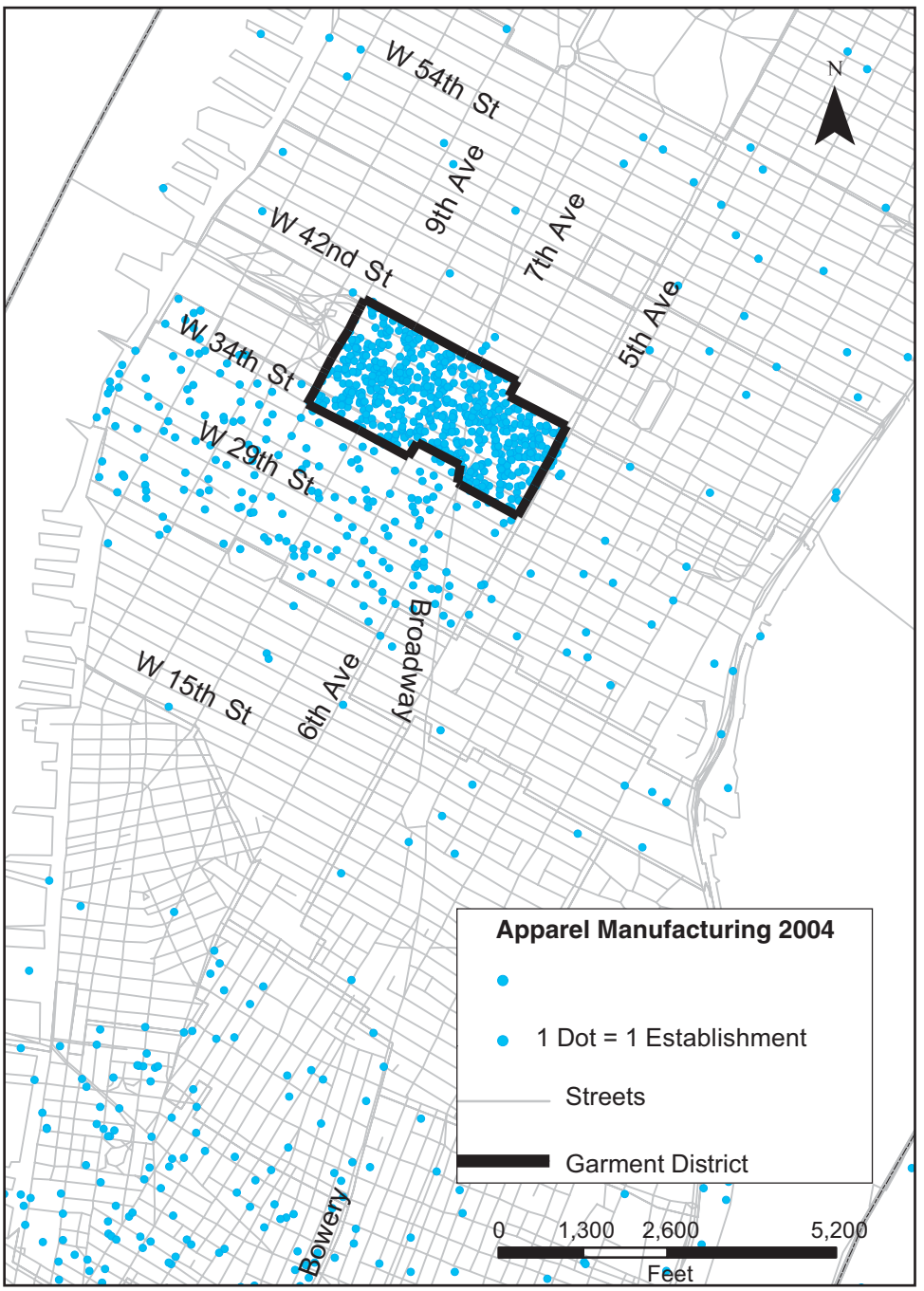


FIGURE 8.9 Apparel manufacturing agglomeration in New York's Garment District. *Data Source*: U.S. Census Bureau: Zip Code Business Patterns, 2004.

the businesses are fashion-related, the principal ones being apparel manufacturers and contractors. However, they also include retailers, textile suppliers, and fashion-design schools, all of which depend on each other for services. Hum (2003) saw similar patterns among Asian and Latino immigrant-owned firms across the river in Brooklyn's Sunset Park neighborhood. Scott (2002a) also noted that the garment industry's geographic configuration nearly always takes the form of a dense agglomeration of firms, even in the contemporary age of globalization (see Figure 8.10). Scott (2002a) showed that Los Angeles has a similar concentration of interacting businesses within its Fashion District:

> This area represents the functional and spatial pivot of the industry and is the source of a multifaceted stream of positive externalities or agglomeration economies, ranging from the services offered by the many specialized sub-contract shops that lie within a stones' throw, to the dense local labour market of garment makers that has developed in the vicinity. (p. 1293)

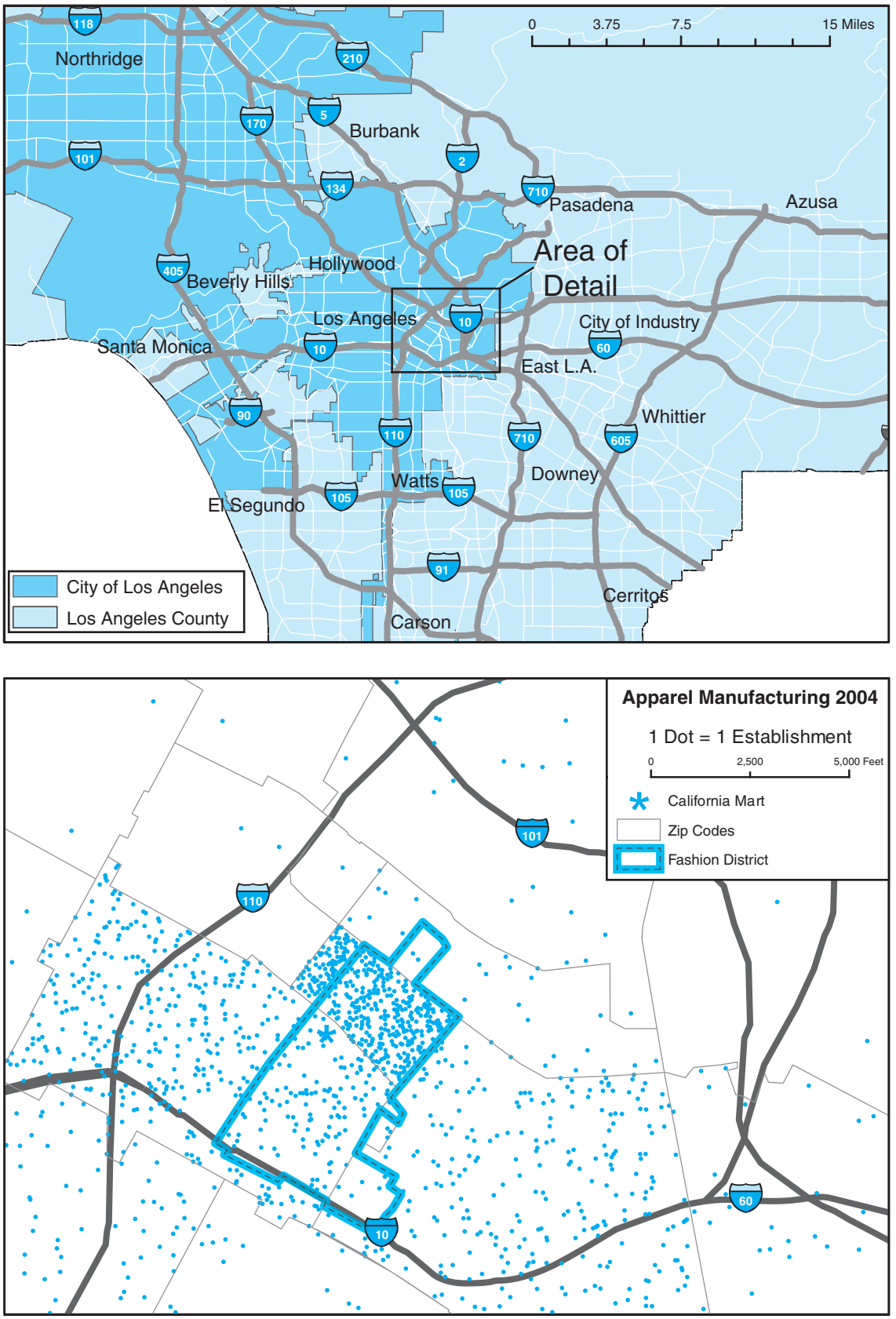


FIGURE 8.10 Apparel manufacturing agglomeration in Los Angeles's Fashion District. *Data Source*: U.S. Census Bureau: Zip Code Business Patterns, 2004.

FIGURE 8.11 Los Angeles's Fashion District.

Scott contended that the Los Angeles Fashion District would soon be on par with those in New York, Paris, London, and Milan (see Figure 8.11).

Even as clothing production gets outsourced from high-cost regions to low-cost regions, agglomeration economies reemerge in the receiving region, as demonstrated recently by eastern Europe (Smith, 2003). Many buyers from clothing industry agglomerations in western Europe have outsourced clothing production to eastern Europe, where agglomeration is occurring in regional clusters (see Figure 8.12).

It may seem odd that, with advancements in information and communication technologies, there would still be a continued trend of agglomeration of economic activity. In particular, the need to locate close to other firms for shared communication advantages through face-to-face contact would appear obsolete given that such transactions can be accommodated nearly instantaneously through the Internet. Liu, Dicken, and Yeung (2004) examined this very issue in a case study of Nokia's manufacturing cluster in Beijing and found that, on the contrary, agglomeration tendencies are being facilitated by the new information and telecommunications technologies.

8.2.4 Intrametropolitan Industrial-Location Theories

A number of theories have been advanced to explain the location of manufacturing within cities. Among these is the incubator theory, which explains the evolution of firms concentrating close to the center and later relocating to the outer edge of the city (Leone & Struyk, 1975). The analogy of the central city as an incubator was proposed because this theory holds that agglomeration economies associated with the high-density core are more favorable to new firms starting out. It was then argued that, once the firm had established itself, it would become more self-sustaining and then be able to relocate to the fringe where other costs, including land, were substantially less.

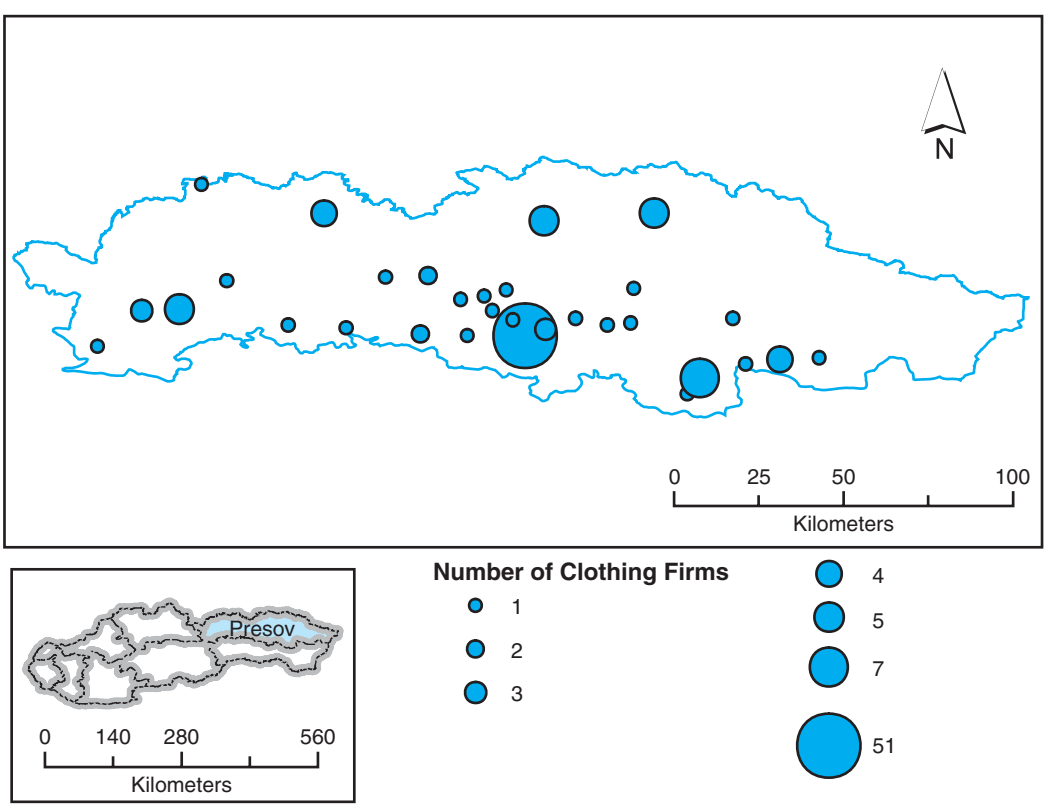


FIGURE 8.12 Distribution of clothing firms in Slovakia. *Source*: Smith, A. 2003. "Power Relations, Industrial Clusters, and Regional Transformations: Pan-European Integration and Outward Processing in the Slovak Clothing Industry." ECONOMIC GEOGRAPHY 79:17–40. Copyright © 2003, John Wiley & Sons. Reprinted by permission. Figure 2. P. 26. Map showing the number of clothing firms in Slovakia.

A critic of the incubator theory, Scott (1982) offered a product-cycle alternative by arguing that in the early stages of a firm, the firm depended on the core of the city for skilled labor and other agglomeration economies. However, with time, the firm would become less dependent on the city and eventually set up branch plant operations in small towns away from the center to benefit from lower costs and better transportation access. Scott and others later challenged the incubator theory because it allowed only for births of firms in the city core and could not explain births occurring outside the core. A study of manufacturing firm relocations in the Chicago region by Stumpf (1996) suggested that the motivations for firm movement from the core to the edge were public policy, infrastructure issues, labor force, and transportation access (see Figure 8.13). The use of trend surface analysis allowed Stumpf to conclude that the dominant movement trend in the Chicago region was biased toward the western suburbs, particularly in the north, as illustrated on the map by the expanding width of

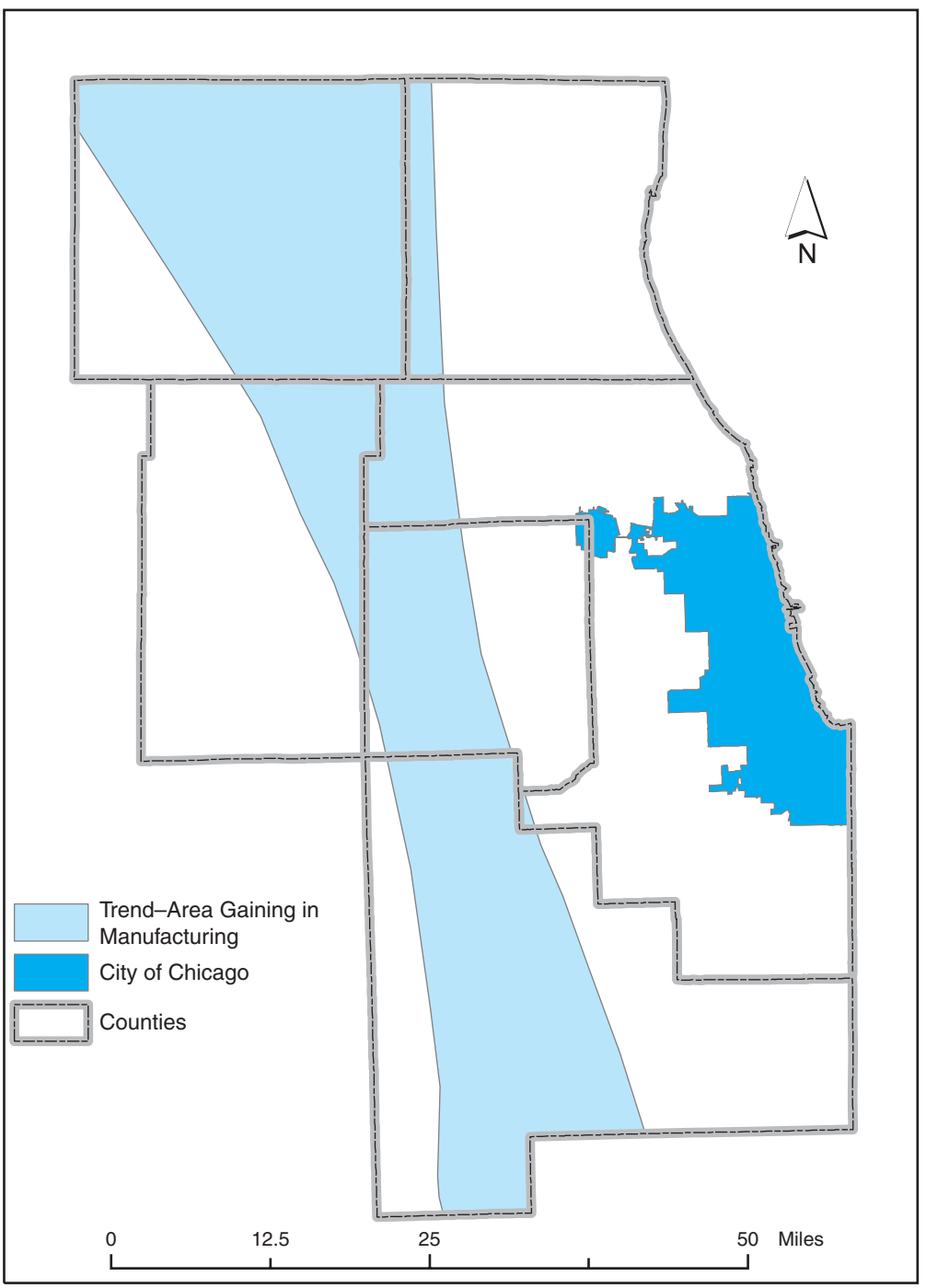


FIGURE 8.13 Pattern of manufacturing firm relocations in the Chicago urban area. *Source*: Stumpf, M.D. 1996. "The Intra-metropolitan relocation of manufacturing firms in the Chicago region, 1987–1992." Master Thesis. Dept. of Geography, Northern Illinois University. Reprinted by permission of Michael Stumpf. Figure. Trend surface.

the trend band in that direction. Ó hUallacháin and Leslie (2009) showed that transportation, and particularly rail transport, continues to play an important role in manufacturing location, even in Sunbelt cities like Phoenix. Their study on Phoenix tested intrametropolitan manufacturing location theories in a Sunbelt context, and they found that agglomeration is sectoral or that manufacturing firms co-locate on the basis of relatedness of sector; for instance, Phoenix textiles and apparel were found in close proximity to furniture manufacturers.

To demonstrate industrial location from an urban geography perspective, the next section, "Analyzing an Urban Issue: Intraurban Industrial Location," examines the distribution of employment in four industrial sectors within the city of Chicago. This urban issue is later pursued in the chapter's geographic information system (GIS) laboratory exercise.

8.3 ANALYZING AN URBAN ISSUE: INTRAURBAN INDUSTRIAL LOCATION

The concentration and agglomeration of economic activity is especially evident in Chicago (see Figure 8.14). Greene (2008) noted that there are distinctive job centers within the city of Chicago that specialize in a particular industry. For instance, manufacturing and warehousing business establishments are located on the periphery of the city, while professional establishments are concentrated downtown (Figure 8.14). Although the map is limited to the city of Chicago, there has been a broader regional trend toward decentralization of manufacturing; yet, even though Chicago has been losing some manufacturing to the edge of the metropolitan region, its Southwest Side continues to specialize in heavy industry that has benefited from good transportation access since the city's origins. This is also true for other cities; for instance, Scott (2002b) showed that manufacturing establishments cluster together in specialized industrial districts, with the Los Angeles region's craft industries concentrating closer to the central city, whereas the high-technology industrial districts take a more peripheral location. Job concentrations in the Los Angeles metropolitan region in the 1990s formed multiple nuclei (Forstall & Greene, 1997).

The conventional explanation for these decentralization patterns has been one of agglomeration economies and lower wages near the center and abundant and inexpensive land on the urban periphery (Blackley & Greytak, 1986). A similar finding has been made for the Dallas area, where high-technology firms are shown to be avoiding the central business district (CBD) and are concentrating toward suburban Richardson, north of downtown, probably to maximize access to a technically skilled labor force (Waddell & Shukla, 1993).

Economic activities outside manufacturing—for instance, professional services or retail—also show clustering, but the amount of clustering and the reasons for it are quite different. Urban geographers have become increasingly interested in resurging downtowns, especially in larger global cities like Chicago. In global cities, the recent trend has been for professional-oriented establishments to further concentrate downtown and for the professionals working in those businesses to reside downtown or nearby in what Greene (2008) refers to as a high amenity zone (HAZ). These high amenity zones generate even more business activity that services the largely upscale residential population in the HAZ, particularly in the arts and entertainment industry. To assess these premises, we examine the distribution of business establishments for four industrial sectors within the city of Chicago, using a location quotient technique.

8.3.1 Location Quotient

There are several methods for measuring an area's industrial specialization. The method we employ in the chapter's GIS exercise is known as a *location quotient*, which expresses the share of employment in a given industry in a specified subarea as a percentage of the share of employment in the same industry within the larger area.

If a location quotient for an area is more than 100, the area is considered specialized in that activity. In the GIS exercise, the subareas are ZIP codes, whereas the larger area is the city of Chicago, and we compute the location quotient (LQ) in the following manner:

$$LQ = ((E_{ij}/E_j)/(E_i/E_t)) * 100$$

where E_{ij} is establishments in subarea j in sector i; E_j is total establishments in subarea j; E_i is city establishments in sector i; and E_t is total city establishments.

Let's look at an example using ZIP code X:

	ZIP Code X	City X
Professional services	8.7%	5.5%
Manufacturing	17.6%	22.8%

To determine ZIP code X's LQs in professional services and manufacturing relative to the city, we plug the above percentages into the following equations:

$$\text{LQ for professional services} = (8.7/5.5) * 100 = 158$$
$$\text{LQ for manufacturing} = (17.6/22.8) * 100 = 77$$

An LQ equal to or greater than 100 indicates that the ZIP code is specialized in that category, and an LQ less than 100 indicates that the ZIP code is not specialized in that category. In this example, the ZIP code is specialized in professional services and not specialized in manufacturing.

8.3.2 A Comparison of Manufacturing and Professional Services Spatial Patterns

Figure 8.14 illustrates that manufacturing establishments dominate in ZIP codes projecting out from downtown in a west-to-southwest pattern. In fact, this pattern is quite old, as the South Branch industrial job center lies in the center of it, along the Chicago River's South Branch and South Fork, which traverses what was once the Union Stockyards. The area also has high concentrations of supporting industries such as wholesale trade, transportation, warehousing, and utilities. This West and Southwest Side concentration of manufacturing establishments depends on nearby working-class neighborhoods for its labor supply. The other major concentration of

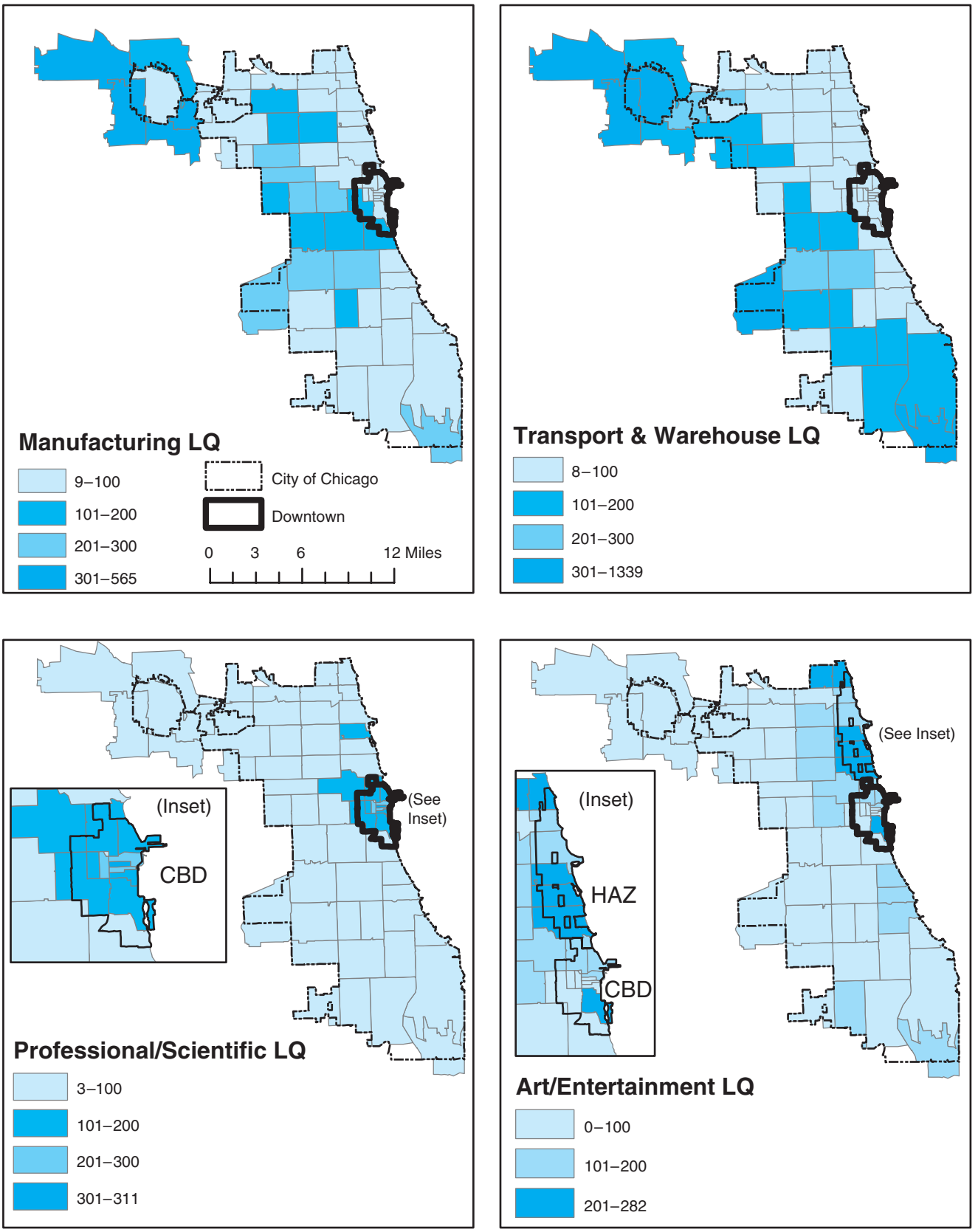


FIGURE 8.14 Comparison of the number of establishments by industry sector and location quotients for the city of Chicago, 2004.

manufacturing establishments surrounds O'Hare International Airport, particularly in planned industrial parks. Similar to the Southwest Side, supporting industry such as warehousing and transportation comingle with manufacturing in and around O'Hare International Airport.

Downtown Chicago is the most specialized part of the city in terms of professional and scientific business establishments (Figure 8.14). This is not surprising given that it includes the CBD, but professional establishments have become even more concentrated here in recent times. A parallel trend to the concentration of professional services downtown has been the increase in residential population, reflected in new high-rise condominiums and apartment buildings that have characterized a building boom for Chicago and other U.S. cities in the most recent decade. Of course, the growth in residential units downtown is stimulated by all of the growth in the professional and scientific industries there. This is a feature of the global city, and especially Chicago, according to Sassen (2004), who suggests that the professional class in such cities would much rather live in the center close to where they work. Greene (2008) identified a North Side HAZ for Chicago that is near the downtown and serves primarily as a residential area for this internationalized professional class. However, the HAZ is not strictly residential, as the consumption tastes of its upscale residents have attracted many other types of business establishments, including arts and entertainment (Figure 8.14). So the ZIP codes with the highest LQs in art and entertainment business establishments extend northward from downtown through this HAZ. Thus, similar to the spatial relationship shown earlier for manufacturing and warehousing, professional and scientific establishments and arts and entertainment are also spatially oriented toward each other.

In the lab exercise, you will calculate LQs for Chicago for the four major industry categories just reviewed. After mapping these distributions, you will examine and compare in an essay the LQ distributions for these industry categories. The exercise lets you apply the concept of LQ to understand the industrial dimensions of a major city.

8.4 INDUSTRY LOCATION TRENDS ACROSS CITIES

Much has been written about the location of manufacturing activities, but as already noted, the economic structure of U.S. cities has undergone and is still undergoing a major transformation characterized by less emphasis on manufacturing and more emphasis on service employment. Noyelle and Stanback (1984) examined this transformation in an urban context by classifying 140 of the largest metropolitan areas according to industrial specialization. A review of their functional classification of cities will help elucidate these important transformations.

In their study, each metropolitan area was placed into a type based on its industrial specialization. The authors used LQs to determine the relative levels of specialization and then a cluster technique to break out those groups of areas that were most similar. The procedure resulted in nine categories of metropolitan areas (see Table 8.2). The 140 metropolitan areas by type are shown in Figure 8.15. The following is a brief definition of each of the nine types of metropolitan areas:

TABLE 8.2 Noyelle and Stanback's Functional Typology of Metropolitan Areas

Type of U.S. Metropolitan Area	Number in 1980
Nodal	39
Functional Nodal	24
Government–Education	15
Education–Manufacturing	5
Residential	3
Resort–Retirement	9
Manufacturing	25
Industrial–Military	13
Mining–Industrial	7

Source: Noyelle, T., and Stanback, T. (1984). *The Economic Transformation of American Cities*. Toronto, Ontario, Canada: Rowman & Littlefield.

1. ***Nodal:*** Metropolitan areas like New York, Chicago, and Atlanta that are specialized in providing distributive and corporate complex services.
2. ***Functional Nodal:*** Metropolitan areas like Detroit, Pittsburgh, and San Jose that are older manufacturing centers where major corporations carry out headquarters and other nonproduction activities.
3. ***Government–Education:*** Metropolitan areas like Washington, DC, Austin, and Madison where government and education comingle (10 on the list are state capitals). These metropolitan areas show a significant emphasis on producer services (see Austin in Figure 8.16).
4. ***Education–Manufacturing:*** Metropolitan areas like New Haven, South Bend, and Ann Arbor that are both old industrial centers and university towns.
5. ***Residential:*** Metropolitan areas like Nassau–Suffolk and Long Branch–Asbury Park, which are both extensions of New York City, and Anaheim, which is an extension of Los Angeles. These areas are now consolidated with their respective largest neighboring metropolitan area, and they have above-average levels of retail and consumer service employment.
6. ***Resort–Retirement:*** Metropolitan areas like Ft. Lauderdale, Orlando, West Palm Beach, and Las Vegas. These places score high in retail and consumer services, but also show a strong presence of finance and corporate services. Amenities make these attractive places for companies offering such services.
7. ***Manufacturing:*** Metropolitan areas like Buffalo, Flint, Greenville, and Erie where manufacturing employment is still strong, if not dominant.
8. ***Industrial–Military:*** Metropolitan areas like San Diego, San Antonio, and Newport News that house military installations.
9. ***Mining–Industrial:*** Metropolitan areas like Tucson, Duluth, and Johnstown that have an overwhelming proportion of their workforce employed in mining or resource-oriented employment.

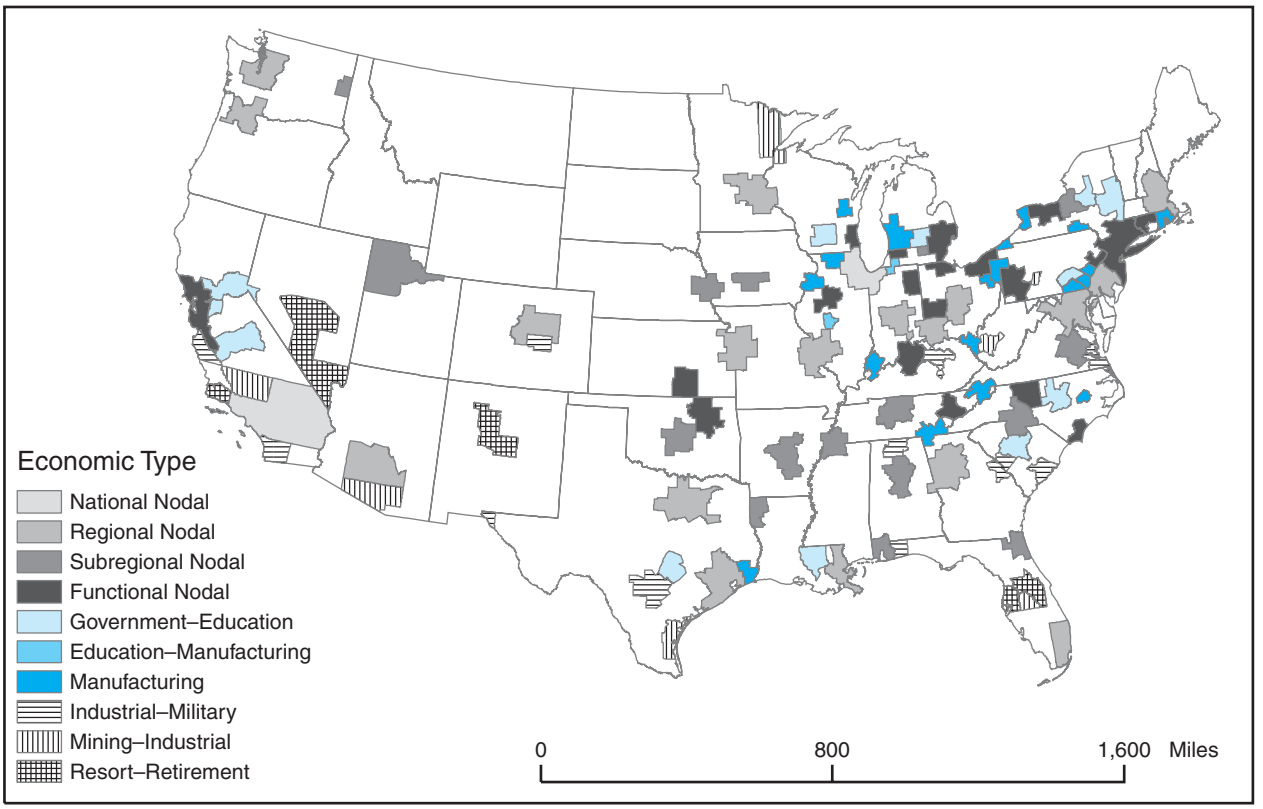


FIGURE 8.15 A functional classification of U.S. metropolitan areas based on industrial specialization.

FIGURE 8.16 Austin, Texas: A government–education metropolitan area. *Source*: Getty Images.

This typology of metropolitan areas helps frame the discussion about the types of places being impacted by broader changes taking place in the economy. The difference between growth and development was an important component of Noyelle and Stanback's (1984) study because they attempted to identify linkages between urban growth and development. The elements of the changing economic structure, such as the growth of services, the rise of white-collar work, and a decrease in production employment, were viewed as development rather than just growth and decline. Furthermore, these changes reflect responses to forces at work in the economy, four of which were singled out by Noyelle and Stanback:

1. The increasing size of markets;
2. Changes in transportation and technology;
3. The increased importance of public-sector and nonprofit activities; and
4. The rise of very large corporations.

These forces were critical in the development of the system of cities represented by the nine types of metropolitan areas. Since the early 20th century, traditional manufacturing was diminished across the largest metropolitan areas and was replaced by the development of high-level services. The economic base of many cities has been transformed from goods-production centers to service-production centers.

A subsequent application of the Noyelle and Stanback (1984) classification of cities revealed that metropolitan areas at the bottom of the functional hierarchy, such as manufacturing centers, had the highest rates of low-income employment, whereas functional nodal metropolitan areas exhibited less low-income employment (Elliott, 1999). The findings on low-income employment across the urban hierarchy imply that vast inequalities are being created among places as a result of the forces identified by Noyelle and Stanback's pioneering work.

8.4.1 High-Technology Industry

Although manufacturing activity has been declining in importance for most large cities, high-technology industry has been a notable exception. Metropolitan area economic development agencies know this, too, as many are obsessed with developing strategies to lure or maintain high-tech industry for their local areas. To identify the strength of a metropolitan area's high-tech industry, urban scholars examine the area's workforce engaged in science and technology occupations. One recent study applied such an occupational definition of high-tech industry and produced a set of metropolitan rankings based on total increases in high-tech jobs in the 1990s, which contrasted with previous rankings that considered high percentages of high-tech workers (Chapple, Markusen, Schrock, Yamamoto, & Yu, 2004). Their results ranked some larger and older industrial areas such as Chicago, New York, and Detroit higher than often-touted areas such as Austin, Raleigh–Durham, and Phoenix. They concluded that areas like Chicago have a large number of high-tech jobs, but they are also diversified, and as a result, they are much less vulnerable to downturns in the economy (see Figure 8.17).

High technology is seen as a driver of economic development partly because it is composed of highly educated, skilled workers (Florida, 2006). Florida (2002) referred to this group of highly educated workers as the "creative class" and suggested that the economic geography of the creative class is strongly associated with high-technology industry locations (see Figure 8.18). Theater and the performing arts are another measure of the creative class, although Markusen and Schrock (2006) show that

FIGURE 8.17 High-tech worker at a manufacturing plant in Chicago.
Source: Corbis.

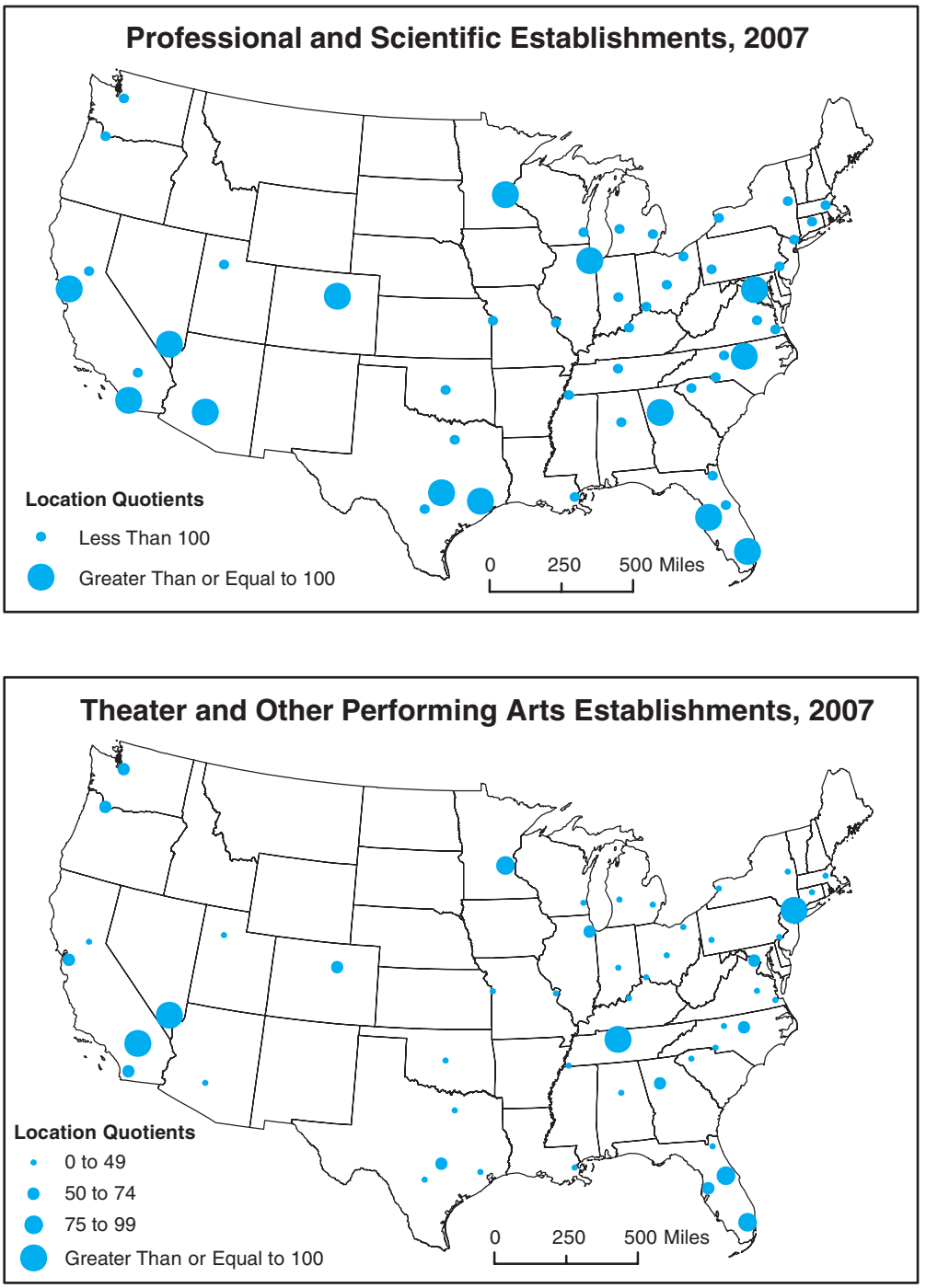

Professional and Scientific Establishments, 2007
Location Quotients
Less Than 100
Greater Than or Equal to 100
0 250 500 Miles
Theater and Other Performing Arts Establishments, 2007
Location Quotients
0 to 49
50 to 74
75 to 99
Greater Than or Equal to 100
0 250 500 Miles

FIGURE 8.18 The geography of creativity in 2007. *Data Source*: U.S. Census Bureau. (2010). The 2007 Economic Census.

artists sort themselves out among American cities in an irregular fashion. The figure shows location quotients (LQs) for professional and scientific establishments and for theater and other performing arts establishments in 2007. The metropolitan areas chosen are the fifty largest according to 2008 populations. Earlier, Florida (2006) noted that this talented creative class was migrating disproportionately to a small number of metropolitan regions, the most notable ones being San Francisco, Los Angeles, Seattle, Boston, Austin, and Denver. He suggested that it is advantageous for metropolitan areas to develop their creative class as an intermediate step to attracting high-technology industry, while metropolitan areas that don't adopt this strategy will be left behind. Scott and Mantegna (2009) found evidence of this trend when they showed that intellectually and socially oriented forms of work are concentrating in large metropolitan areas, while physically oriented work is concentrating in smaller metropolitan areas.

The creative class literature has mushroomed in recent years with many extensions of Florida's ideas, as well as critiques of his ideas. Indergaard (2009), for instance, recently identified a creative corridor in Lower Manhattan that he referred to as "Silicon Alley," a corridor that has been spurred on with the help of the new politics of the creative industry and

real estate interests. Currid (2009) geocoded thousands of Getty images from Los Angeles and New York, and her "hot spots" for New York City corresponded with "Silicon Alley," but her area was much bigger, and she argued that the fashion, art, and music captured in the Getty images make up the creative industries that drive growth, even more so than the finance, science, and high-tech sectors that support entertainment.

8.5 *MAQUILADORA* INDUSTRY ON THE MEXICO–UNITED STATES BORDER: A UNIQUE MANUFACTURING REGION

The *maquiladora* industry, located mostly on the Mexico–United States border, represents an important and successful international manufacturing arrangement (see Figure 8.19). It illustrates many of the concepts raised in this chapter. *Maquiladora* industry is coproduction of manufactured goods where most of the components are transported from the United States or other advanced countries to Mexico, assembly is done by low-cost labor in Mexico, and assembled products are shipped for sale in U.S. markets. The legal apparatus consists of a U.S. or sometimes a Japanese or Korean company working with a Mexican counterpart firm that it controls. Usually, the top executives and managers at the Mexican plant are American, often commuting from residences on the U.S. side, whereas most of the middle- and lower-level employees are Mexican and live on the Mexican side.

Today, many products familiar to U.S. consumers have largely been assembled in *maquiladora* factories. These include refrigerators, batteries, TV sets, windshield wiper blades, airplane components, auto parts, and more traditional products such as textiles and furniture (Stoddard, 1987). An example is Trico Components, which was the fifth largest Mexican *maquila* plant in 1996 (Butler, Pick, & Hettrick, 2001; Sklair, 2010). It manufactures windshield wipers and wiper blades, and its market includes the major U.S. automakers as well as many third-party firms. In 2010, Trico was owned by Kohlberg and Company, it was producing 47 million wiper blades yearly plus other products such as motors and lighting control modules, and it employed 3,000 workers (Trico Products, 2010). Trico follows the traditional pattern of twin plants near each other on opposite sides of the border. Trico's Brownsville manufacturing plant produces nearly all of the components for its Mexican plant in Matamoros. In particular, the U.S. plant does metallurgy, casting, stamping, and manufacture of wiper blade arms. It also is the distribution center for shipping wipers and blades worldwide. Every morning 16 large semitrailer trucks carry components from the Brownsville Trico plant to the Trico Componentes plant, located nine miles across the border in a modern industrial park in Matamoros. There the components are assembled into wiper blades and blade motor assemblies. At the end of each day, the trucks carry finished products back to the Brownsville Trico plant. The major global auto companies then come to the Brownsville plant every few days to pick up batches of new products. The whole turnaround from raw materials to finished product and delivery takes only about 5 days.

FIGURE 8.19 *Maquiladora* workers at plant near the Mexican border. *Source*: The Image Works.

Trico is remarkable in dominating the U.S. automotive market for wiper blades. The twin border plants manufacture 62 million blades, arms, wiper motor assemblies, and other items per year. Trico has 80 percent of the U.S. market for blades and arms and 45 percent of the market for motor assemblies. Its customers include Ford, Chrysler, ITT Automotive (which sells to GM and Toyota), CME (which sells to Honda), Nissan, and ASMO (which sells to Toyota and Chrysler), as well as retailers Pep Boys, Carquest, Atlas, and Wheels. Trico Products has come through the Great Recession of 2007–2009 owned by a private equity firm (Trico Products, 2010).

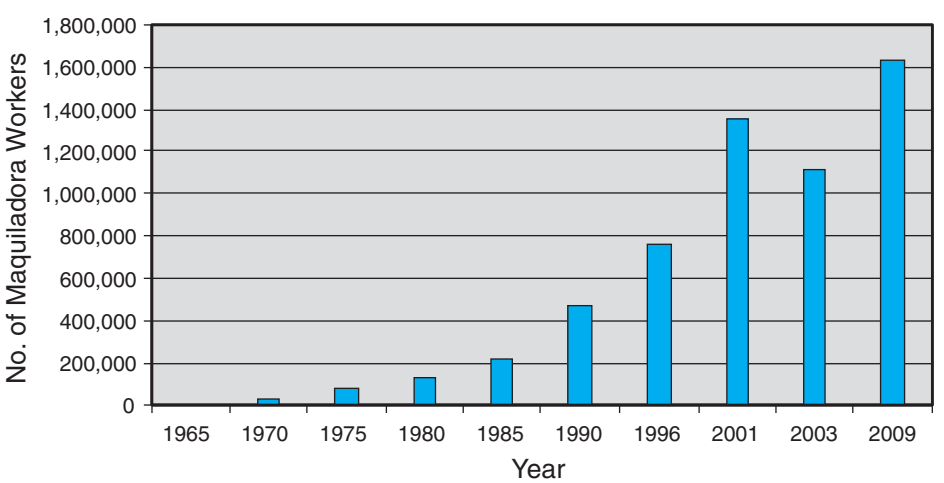
The *maquiladora* industry started in the mid-1960s and grew exponentially until 2001, when a recession began in the United States and competition grew from Asian *maquiladora*-like production, especially in China ("Wasting Away," 2003). After three decades of growth and recent decline, the *maquiladora* sector, vis-à-vis the Mexican economy, represents one of Mexico's largest export sectors—behind petroleum and equivalent to tourism (Butler et al., 2001).

As seen in Figure 8.20, the growth in the number of *maquiladora* workers has been huge. *Maquiladora* employment peaked at nearly 1.4 million in 2001, before falling by around a quarter million as a result of the U.S. recession and increasing global competition ("Wasting Away," 2003) and then reaching an all-time high level in 2009 due to mid-decade growth and cost advantages (INEGI, 2010). The Mexican states with the largest *maquiladora* industry are located predominantly at the northern border, but also include several states with large urban areas in the center of the country and even the southeastern state of Yucatan. The employment in these states is given in Table 8.3 for 2009, a year in which there were about 1.6 million *maquiladora* employees, one of which is shown in a computer plant in Figure 8.21. In the 2000–2010 decade, *maquiladora* employment was reduced in the border states by 15 percent and increased in large central states—particularly

TABLE 8.3 Mexican *Maquiladora* Employment, 2009

State	*Maquiladora* Employment	Percentage of National Total
Border States		
Chihuahua	230,196	14.2
Baja California	206,515	12.7
Tamaulipas	144,582	8.9
Coahuila	132,991	8.2
Sonora	82,021	5.0
Nuevo Leon	185,023	11.4
Nonborder States		
Durango	19,446	1.2
Jalisco	94,737	5.8
Aguascalientes	35,514	2.2
Puebla	65,062	4.0
Yucatan	21,183	1.3
Distrito Federal	52,880	3.3
State of Mexico	104,430	6.4
Others	232,288	14.3
Border States Subtotal	981,329	60.4
Total	1,624,506	100.0

Source: INEGI. (2010). "Industria manufacturera, maquiladora y de servicios de exportación." *Banco de Información Económia.* Aguascalientes, Mexico: Instituto Nacional de Estadística y Geografía.



	1965	1970	1975	1980	1985	1990	1996	2001	2003	2009
Maquiladora Enterprises	12	120	454	620	760	1,920	2,411			5,259
Maquiladora Employment	3,000	20,327	67,241	119,546	211,969	460,258	754,858	1,340,000	1,100,000	1,620,596

FIGURE 8.20 Growth of *maquiladora* employment, 1965–2009.

FIGURE 8.21 Automotive *maquiladora* worker at a plant in Mexico City. *Source*: AP Wide World Photos.

the Distrito Federal, State of Mexico, Jalisco, and Puebla, which include the metropolises of Mexico City, Guadalajara, and Puebla. This implies that the distance factor in a gravity model would be less influential than 10 years ago, while transportation costs may have dropped as the North American Free Trade Agreement (NAFTA) has evolved. An adverse factor was the decade's growing drug-related crime and social disorganization. The same deconcentration away from the border toward the center is evident with the number of *maquiladora* establishments (INEGI, 2010).

Rapid *maquiladora* growth has been accompanied by parallel growth of the Mexican cities that house the industry—notably Tijuana, Mexicali, Ciudad Juarez, Reynosa, and Matamoros. *Maquiladora* industry has been the principal engine driving the growth of these cities, with the secondary factor being their proximity to the United States. Each of the Mexican border cities has a U.S. sister city, located just across the border. For instance, San Diego is across from Tijuana and El Paso across from Ciudad Juarez. The U.S. part of coproduction, consisting of such factors as distribution, warehousing, and product development, tends to be located in the U.S. sister city.

The *maquiladora* industry illustrates the industrial location concept of economic-base theory and agglomeration economies. The influx of workers also demonstrates the migration application of the gravity model from Chapter 6. In addition, Mexican labor costs are about one-eighth the cost of equivalent labor on the U.S. side of the border. Although transport costs from *maquiladora* plants to U.S. consumption locations are greater than they would be for U.S.-based production, this is far more than offset by the labor savings available in Mexico.

Economic-base theory is demonstrated because the *maquiladora*'s rapid growth stimulated concomitant rapid population and economic growth of Mexican border cities and surrounding areas, including ancillary services in those cities. The case also illustrates agglomeration economies because *maquiladora* firms producing similar products are usually spatially grouped together to benefit from common supplies and producer services. This is shown by the spatial proximity of major TV set *maquiladoras* in Tijuana and by the more traditional grouping of textile *maquiladoras* in Matamoros.

The gravity model of migration introduced in Chapter 6 is demonstrated because, despite the growing crime, the relatively prosperous economies of the Mexican border cities have been a major pull factor for migrants from central Mexico, whereas distance of migration has been small, a favorable factor for lower-level *maquiladora* workers, mostly young women migrating from nearby rural areas of the border region.

Several geopolitical factors have also influenced the *maquiladora* industry. NAFTA, approved in 1994, gradually eliminated special Mexican tax incentives on *maquiladora* production, also giving trade preference to U.S. versus Asian *maquiladora* firms. The overall effects on this industry have been mixed.

A more formidable and global challenge to the Mexican *maquiladora* industry, however, is the rise of very cheap coproduction in China and other Asian nations that is positioned for the U.S. market. A number of *maquiladora* plants have been closed and moved to China, Malaysia, and other low-cost Asian countries in the last decade. In 2003, the Mexican *maquiladora* assembly worker received about $2 per hour, whereas the Chinese assembly worker earned only 50 to 80 cents per hour ("Wasting Away," 2003), a differential that remains significant, although narrower. It is unknown how far this Asian offshore trend will go and what its ultimate effect will be on Mexico and on consumers in the United States.

8.6 CONSUMER SERVICES AND CITIES

Two types of service employment can be identified: consumer services and producer services. Consumer services deal with the final consumption of goods and services and therefore are principally related to the retail industry. Producer services, on the other hand, relate to intermediate demand or aid in the production of other goods and services; they might include, for instance, legal services for a financial corporation or a manufacturing firm. Producer services are the topic of the final section of the chapter, while this section focuses on consumer services.

Retailing is an important industrial component of the city, not only because a large share of a metropolitan area's workforce is engaged in retail, but also because retailing shapes many of the daily activity patterns of consumers. Research on the geography of retailing concerns both the location and the forms that retail clusters take within metropolitan areas, but it

also addresses consumer behavior with respect to shopping travel patterns.

8.6.1 Retail Location Patterns Within Cities

Retail employment in the United States increased by 7 percent from 2002 to 2007, when there were 16 million retail workers (U.S. Census Bureau, 2009), although it dropped during the 2007–2009 recession. In addition, retail sales between 2000 and 2007 increased by 29 percent. These two trends speak to the importance of retailing in cities as places of both employment and consumption. It raises the important question of where workers and consumers go within the city for this retail activity.

Prior to the automobile's influence on city form, the CBD was the dominant location of retail activities. With the increased suburbanization of population, large-scale retailing soon followed. Similar to the suburbanization of population, retailing oriented itself along transportation routes, often in radial patterns. There is always a lag between when people arrive in an area and when retail services are offered. In many respects, the latter is an extension of central place theory, already discussed in Chapter 4, although the city displays a much more complex pattern of hierarchal centers because of widely varying population densities and socioeconomic characteristics.

Central cities remained strong throughout the 1950s and 1960s, and as a result, retailing in the CBD and along corridors extending outward from the CBD also remained viable. Nevertheless, this would prove to be short-lived as shopping centers began to develop rapidly across metropolitan areas. The regional mall, one of the largest types of shopping center, first appeared in the 1950s, although there were prototypes dating back to the 1920s (Hartshorn, 1992). The Northgate Center, built in 1950 in Seattle, was the first to meet today's definition of a regional mall, as it included a major department store anchor. Southdale Shopping Center in Minneapolis (1956) was the first regional mall to be fully enclosed (Hartshorn, 1992). Many variations of regional malls would follow after the 1950s, including mixed-use centers, megamalls, and theme centers (see Figure 8.22).

Shopping centers in the United States in 2004 numbered approximately 47,718, and many have been renovated or are under renovation; fewer are newly constructed (The "Shopping Center Industry," 2005). Also in that year, U.S. shopping center sales were $2.02 trillion, and 421 shopping centers had more than 1 million square feet. Shopping centers face competition from a number of other shopping formats. A relatively new phenomenon introduced to the metropolitan landscape is known as a power center. There is no standard definition of a power center, but it normally implies an agglomeration of big-box retailers (Hahn, 2000). Big-box retailers include category killers offering a wide selection in a special category at a low price such as Home Depot, Best Buy, and The Sports Authority; discounters such as Walmart and Target; and warehouse clubs such as Sam's Club. Power centers often locate near regional shopping centers, but do not compete directly with them; instead, they compete with local community shopping centers (Hahn, 2000). Power centers consume a lot of space in terms of building and parking area, and their popularity has resulted in increased travel time for consumers as they bypass local community centers for better bargains (Hahn, 2000).

A more recent newcomer to the metropolitan retail landscape is the lifestyle center, which is anchorless and offers upscale retailing and fine dining to consumers in a convenient, open-air layout (Hazel, 2003). The concept attempts to create a hub of activity by accommodating a mix of uses that might include residential development, office space, hotels, churches, or municipal facilities (Mattson-Teig, 2004). The focus is on the consumers and their community, rather than on a particular tenant of the center. The number of these lifestyle centers has nearly doubled since 1997, and there are now nearly 60 (see Table 8.4 for a partial list). Lifestyle centers include upscale retailers and are located in affluent areas. An example is Victoria Gardens, which is also currently the largest at 1.3 million square feet of space, located in Rancho Cucamonga, an affluent suburb of Los Angeles. The introduction of the lifestyle center is indicative of the extreme competition that exists in the retail industry, where retailers are frequently looking for new twists in their product delivery (see Figure 8.23, page 259). Wrigley and Lowe (2002) observed a similar trend of new retail formats in the United Kingdom such as warehouse clubs and factory outlet centers.

FIGURE 8.22 Eaton's Mall in Toronto.

8.6.2 The Consumer City Hypothesis

The *consumer city hypothesis* offers a provocative viewpoint on consumer services and cities that deemphasizes the role of production in the growth of cities and emphasizes the role of consumption (Clark, 2004). Advocates of this hypothesis go so far as to suggest, for cities, that "trying to keep manufacturing is probably useless and because of the negative amenities related to manufacturing possibly even harmful" (Glaser, Kolko, & Saiz, 2003, p. 179). They suggest cities should attract people with high human capital or talent because this group will have the highest income-earning potential and thus the highest demand for consumer products and services. They noted four urban amenities critical for the future growth and economic health of cities:

1. A rich variety of consumer goods and services. Cities that have more restaurants and offer plenty of entertainment have grown the fastest.

TABLE 8.4 Lifestyle Centers Built in the United States Between 1990 and 2002 (Updated as of February 2003)

Year Opened	Name	City, State	Total Gross Leasable Area (ft^2)	Total Stores*
2002	Eastwood Towne Center	Lansing, MI	393,000	45
2002	Village of Rochester Hills	Rochester Hills, MI	375,000	40
2002	The Grove	Los Angeles, CA	575,000	44
2002	Fountain Walk	Novi, MI	737,134	13
2002	Geneva Commons	Geneva, IL	418,673	61
2001	Aspen Grove	Littleton, CO	243,900	50
2001	The Summit Louisville	Louisville, KY	367,500	58
2001	The Shoppes at Brinton Lakes	Glen Mills, PA	153,000	14
2001	Old Mill District at River Bend	Bend, OR	150,000	23
2001	Jefferson Pointe	Fort Wayne, NJ	562,000	60
2000	Deer Park Town Center	Deer Park, IL	506,000	60
2000	Rookwood Commons	Norwood, OH	326,462	45
2000	Palladium at CityPlace	West Palm Beach, FL	600,000	75
2000	Centro Ybor	Tampa, FL	313,899	25
1999	SouthPointe Pavilions	Lincoln, NE	500,000	42
1999	Mt. Pleasant Towne Center	Mt. Pleasant, SC	426,748	62
1999	Southlake Town Square	Southlake, TX	201,000	70
1999	The Avenue at East Cobb	Marietta, GA	225,000	52
1999	The Shops at Sunset Place	South Miami, FL	506,000	60
1999	The Avenue of the Peninsula	Rolling Hills Estates, CA	374,000	60
1999	Premier Centre	Mandaville, LA	275,026	22
1998	Denver Pavilions	Denver, CO	350,000	40
1998	Gardens on El Paseo	Palm Desert, CA	200,000	50
1998	The Shops at Riverwoods	Provo, UT	192,000	35
1998	The Commons at Calabasas	Calabasas, CA	198,388	35
1997	Alamo Quarry Marketplace	San Antonio, TX	585,000	60
1997	Huebner Oaks Shopping Center	San Antonio, TX	380,000	60
1997	The Summit Birmingham	Birmingham, AL	760,000	72
1997	Redmond Town Center	Redmond, WA	569,000	100
1997	University Village	Seattle, WA	400,000	93
1996	Town Center Plaza	Leawood, KS	700,000	95
1996	The Promenade at Westlake	Thousand Oaks, CA	201,563	28
1992	Town Square Wheaton	Wheaton, IL	179,000	75
1991	Mizner Park	Boca Raton, FL	236,000	47
1990	Reston Town Center	Reston, VA	250,000	50
1990	Bradley Fair Shopping Center	Wichita, KS	220,000	35
1990	CocoWalk	Coconut Grove, FL	163,000	40

*Store count includes restaurants.

Source: Hazel, D. 2003. "Lifestyle centers look good, but are they earning their keep?" SHOPPING CENTERS TODAY (ICSC monthly magazine cover story), May 2003. Reproduced by permission of International Council of Shopping Centers.

2. Aesthetics and physical setting. Physical amenities such as favorable climate, rolling terrain, higher ground, and proximity to water are all attractive to consumers.
3. Good public services. Good schools and low crime rates are important for attracting a highly educated workforce.
4. Transportation infrastructure makes getting around easy, as consumers avoid areas with high transport costs.

One phenomenon often cited in support of the consumer city hypothesis is reverse commuting from dense downtowns, a situation where some residents choose to reside in the center of the city even though their jobs might be in the suburbs (see Table 8.5). These residents choose to stay in the central city, where rents are higher, because it is convenient to consume high-quality consumer goods and services.

Clark (2004) extended the theory by differentiating between natural amenities and constructed amenities. Natural amenities have been considered in past studies to be a major determinant of growth (Mueller-Wille, 1990). Constructed amenities include opera houses, juice bars, museums, and coffee shops. An example, seen in Figure 8.24 (page 260), of an elaborate constructed amenity is the Experience Music Project in Seattle (http://www.empsfm.org). Perhaps what is most

FIGURE 8.23 Geneva Commons lifestyle center in suburban Chicago.

radical about this approach is that it turns classical retail geography around, in that it has always been suggested that, once a critical mass of consumers is reached in an area, a service such as a coffee shop will be offered. Here, however, it is suggested that people move toward amenities like a coffee shop. The detail of the argument is as follows:

> This reasoning may seem simple, but it reverses the "traditional economic determinism" which suggests that as individuals (and cities) grow more affluent, they consume more luxury goods, like meals in fine restaurants. In this traditional view, individuals with more income cause restaurants to emerge. But if this is broadly applicable over an individual's life course, to apply the same logic to a city is mistaken, powerfully illustrating overextended "methodological individualism." Why? Because discrete individuals move in and out of cities all the time, yet urban amenities like opera or lakefronts change more

TABLE 8.5 Commuting Patterns in U.S. Metropolitan Areas

	Daily Commutes (millions)			Annualized Growth Rate	
	1960	1980	1990	1960–1980	1980–1990
City–city	18.8	20.9	24.3	0.52%	1.52%
City–suburb	2.0	2.6	5.9	3.65%	3.46%
City–other	0.6	1.2	1.9	3.63%	4.70%
Suburb–city	6.6	12.7	15.2	3.34%	1.81%
Suburb–suburb	11.3	25.3	35.4	4.09%	3.42%
Suburb–other	1.1	3.7	6.8	6.22%	6.27%
Total	40.5	68	89.5	2.62%	2.79%

Source: Glaser, E., Kolko, J., and Saiz, A. (2001). "Consumer city." *Journal of Economic Geography* 1:27–50. Table 1, "Commuting patterns – U.S. Metropolitan Areas," p. 34.

FIGURE 8.24 Experience Music Project, Seattle's Rock and Roll Museum.

> slowly, and thus drive location decisions of individuals. This is especially true for talented and younger persons who change jobs frequently—and even the average American changed jobs about every four years in the 1990s. (Clark, 2004, p. 105)

The two different views might actually be complementary where a critical mass is reached and the coffee shop is provided, but the coming of the coffee shop encourages additional growth. Constructed amenities have been found to drive growth where young people abound, whereas natural amenities explain the growth of areas of elderly residents (Clark, 2004).

Greene (2008) used the term *high amenity zone* (HAZ) to suggest that the types of amenities being discussed in the consumer city literature are highly concentrated in cities. The concept came about from a surprise finding when examining the relationship between job density and net in-commuting into census tracts for Chicago and Los Angeles. The results showed that the neighborhoods that had lots of jobs, but did not qualify as job centers because of high residential densities, were clustered next to downtown and other close-in job centers. For instance, in Los Angeles, these areas filled the gaps between the downtown, Hollywood, Beverly Hills, and Santa Monica job centers, and they tended to represent high-density, upscale residential areas whose residents supported neighborhood retailing and service employment (Figure 8.25). Wilshire Boulevard is the major street connecting these job centers with upscale residential areas, with lots of service jobs fanning off to the side (Figure 8.26).

A somewhat similar area was identified in Chicago, likewise contiguous to downtown and extending up the North Side and also an upscale residential zone where 42 percent of its working residents commuted downtown (Figure 8.27, page 262). For Chicago, Greene (2006) also examined the distribution of Starbucks retail outlets relative to the downtown, its HAZ, and the remaining areas of the city (Table 8.6, page 262). Starbucks is a critical component of the consumer city hypothesis, as they are equal to juice bars in the original treatise on the concept by Clark (2004). Starbucks outlets were used as a cultural marker, indicative of the creative class who are the drivers of growth in the consumer city. Addresses for Chicago proper's Starbucks, excluding O'Hare International Airport, were obtained from the company's website and then geocoded and incorporated into the GIS for an overlay with the HAZ (Figure 8.28, page 263). Starbucks outlets were especially concentrated in the downtown, the North Side HAZ and adjacent areas, and Hyde Park; otherwise, there were vast areas of the city without any Starbucks. Comparing the populations that were served by Starbucks in the three zones—the North Side HAZ, downtown, and everywhere else—illustrated the importance of Starbucks as an amenity and even as a possible driver of growth in Chicago's North Side HAZ (Table 8.6). Greene (2009) extended

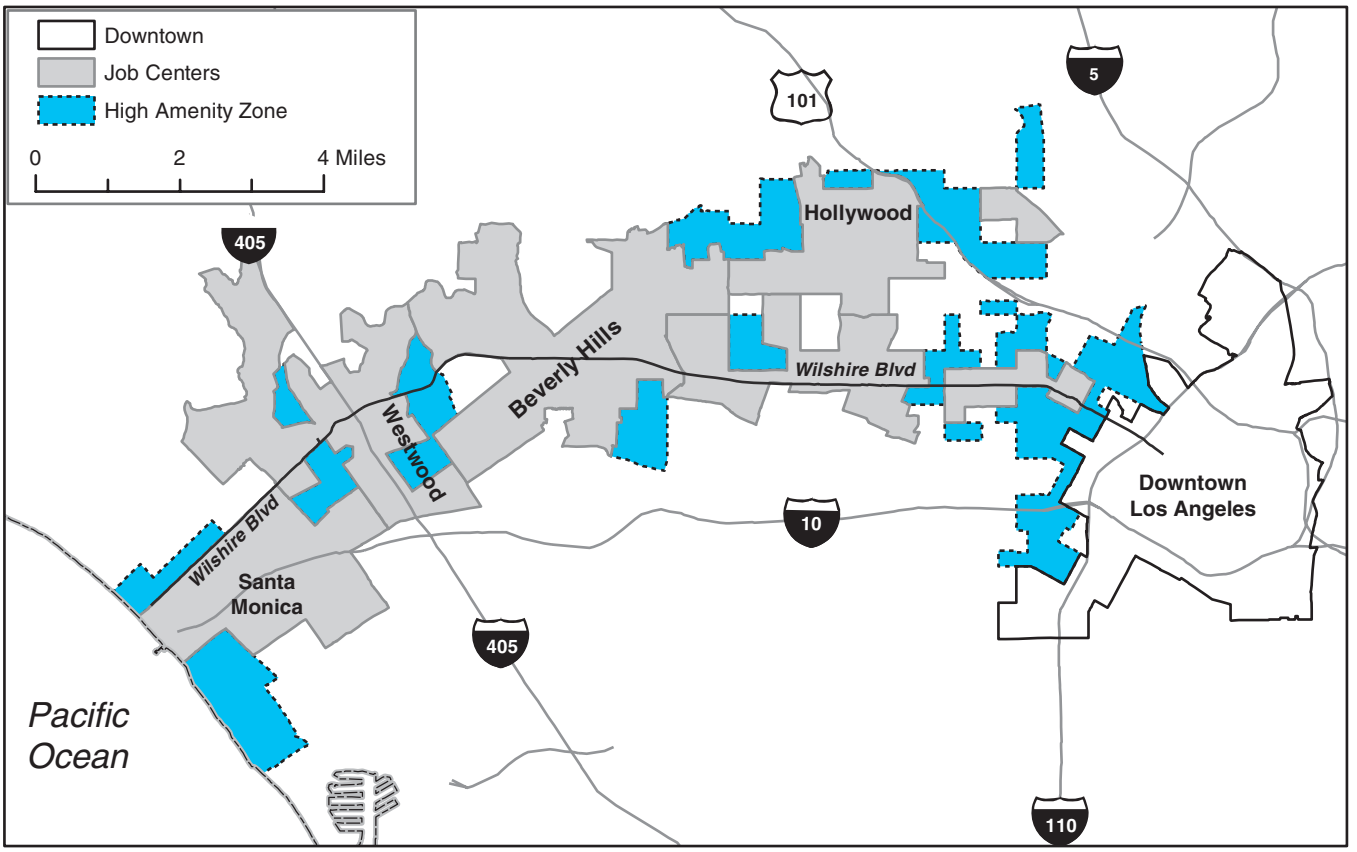


FIGURE 8.25 Job centers in the Los Angeles urban area with high concentrations of professional services.

the Starbucks analysis to Guangzhou, China, where a similar HAZ has emerged in and around the new Tian He district's CBD (Figure 8.29, page 263).

Another U.S. nationwide study gave more weight than many investigations to the local consumption base. Expanded local consumption is posited to have multiplier effects, depending on what local business owners and employees spend their incomes on (Markusen & Schrock, 2009). This also can occur with local production that is export oriented. A study of 50 metropolitan areas in the United States examined particular occupation groups that were localized within the cities and that included farming, fishing, forestry, production, high technology, health care, legal services, engineering/architecture, and arts/design/entertainment/sports/media ("culture") (Markusen & Schrock, 2009). Culture and health care were examined in detail as cases, and they demonstrated both consumption-based and export-oriented activity. This study points to the need not to categorize economic units as consuming or exporting ones, but to consider them as blends of the two types.

FIGURE 8.26 Wilshire Boulevard business area.

8.7 CONSUMER INTERACTION IN TWIN CITIES ON THE UNITED STATES–MEXICO BORDER

An international example of a consumer city is the consumer interaction for the U.S.–Mexican sister cities that were discussed earlier regarding *maquiladoras.* Both sides of the border see advantages to shopping consumption on the other side. Shoppers often drive, but sometimes walk to the other side. Walking has been even more popular since the 9/11 terrorist attack because the tightened security means that there are now longer lines of cars to cross the border from Mexico to the United States. The large number of border pedestrian shoppers

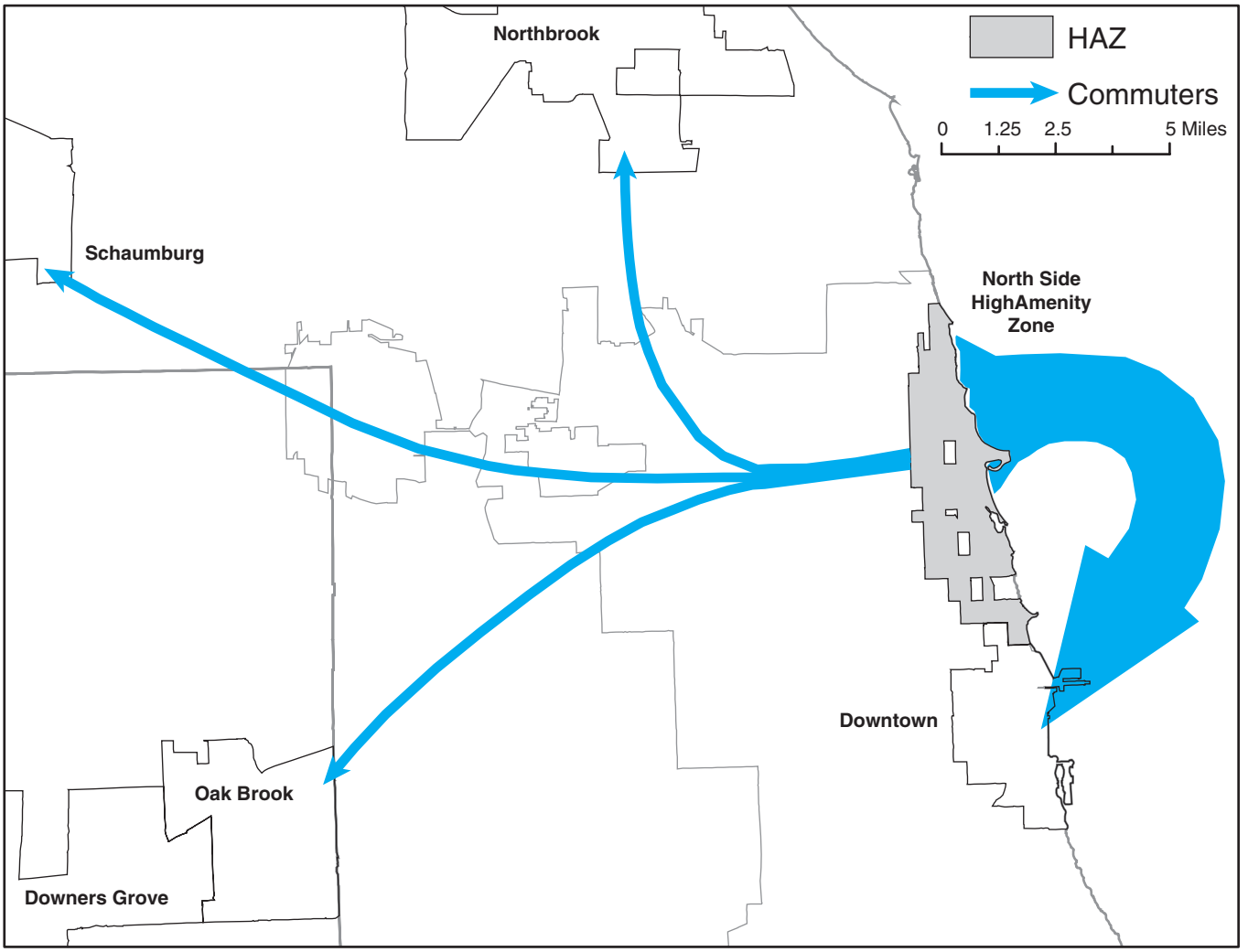


FIGURE 8.27 High-density, upscale residential areas on Chicago's North Side.

was evident in 1997, as illustrated in Table 8.7 (see page 264); for all the border cities, 45 million pedestrians crossed into the United States in that year (U.S. Customs Service, 1997).

A short case example gives the feeling of this shopping in the quad cities of Brownsville and McAllen, Texas, and the Mexican sister cities of Matamoros and Reynosa, Mexico, all located at the easternmost part of the border not far from the Gulf of Mexico. The U.S. side of this region is referred to as "the Valley" and has a strong cultural influence from Mexico and Mexican-Americans. The Valley is heavily Hispanic and has experienced a large

TABLE 8.6 Starbucks and Population Served in Chicago

	Number of Starbucks*	Population in 2000**	Square Miles	Population Served by a Starbucks
Downtown	56	601,950	8	10,724
North Side HAZ	28	300,275	10	10,749
North Branch Industrial	8	35,362	4	4,420
Remaining Areas	25	2,469,312	208	98,772

*Excludes Starbucks at O'Hare Airport Terminal.

**Population for Downtown is Daytime Population.

Source: Greene, R. P. (2006). "Strong downtowns and high amenity zones as defining features of the 21st century metropolis: The case of Chicago." In *Chicago's Geographies: Metropolis for the 21st Century*, edited by R. P. Greene, M. J. Bouman, and D. Grammenos. Table 7, "Starbucks and population served in Chicago," p. 70. Washington, DC: Association of American Geographers.

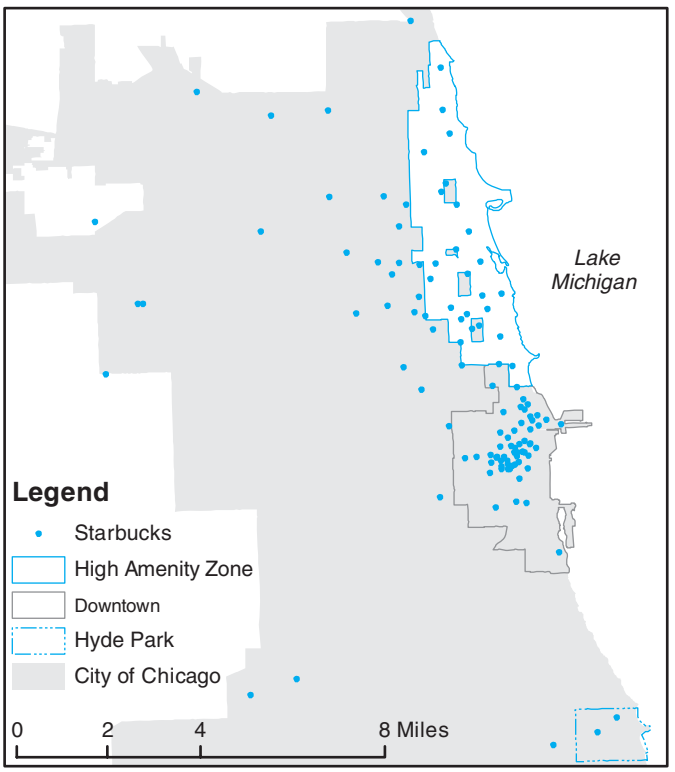


FIGURE 8.28 Chicago Starbucks in high amenity zone.

increase in overall population in the past 10 years. Brownsville and Matamoros had 2000 populations of 139,722 and 516,001, respectively, whereas the population of McAllen in 2000 was 106,414, and Reynosa across the border had 403,718 residents. The populations are larger today; the Brownsville and Matamoros metropolitan areas in 2008 had grown by 17 and 28 percent, respectively (U.S. Census Bureau, 2010b).

On the Mexican side, the region's economy is powered by *maquiladoras.* In the past decade, crime and insecurity have increased. However, there are high unemployment and poverty rates on the U.S. side, as well as historically low levels of education, although the state of Texas is investing heavily in remedies at the university level. Quite a lot of agriculture is also present, the best known being citrus production.

The Valley offers tourism and leisure as well. For instance, it is a retirement mecca, and South Padre Island near Brownsville is an ever-popular destination, especially for spring break vacationers. "Winter Texans" are a special feature; typically, they are older Midwesterners who spend the winter in south Texas. Many of these Winter Texans live in the RV and trailer parks that are scattered up and down the Valley; there are more than 500 of them, with a total of 68,000 spaces (Valley Partnership, 2004). The Winter Texans provide consumer benefits to local merchants, especially in Brownsville and Matamoros (Valley Partnership, 2004), as well as shopping and providing consumer benefits on the Mexican side.

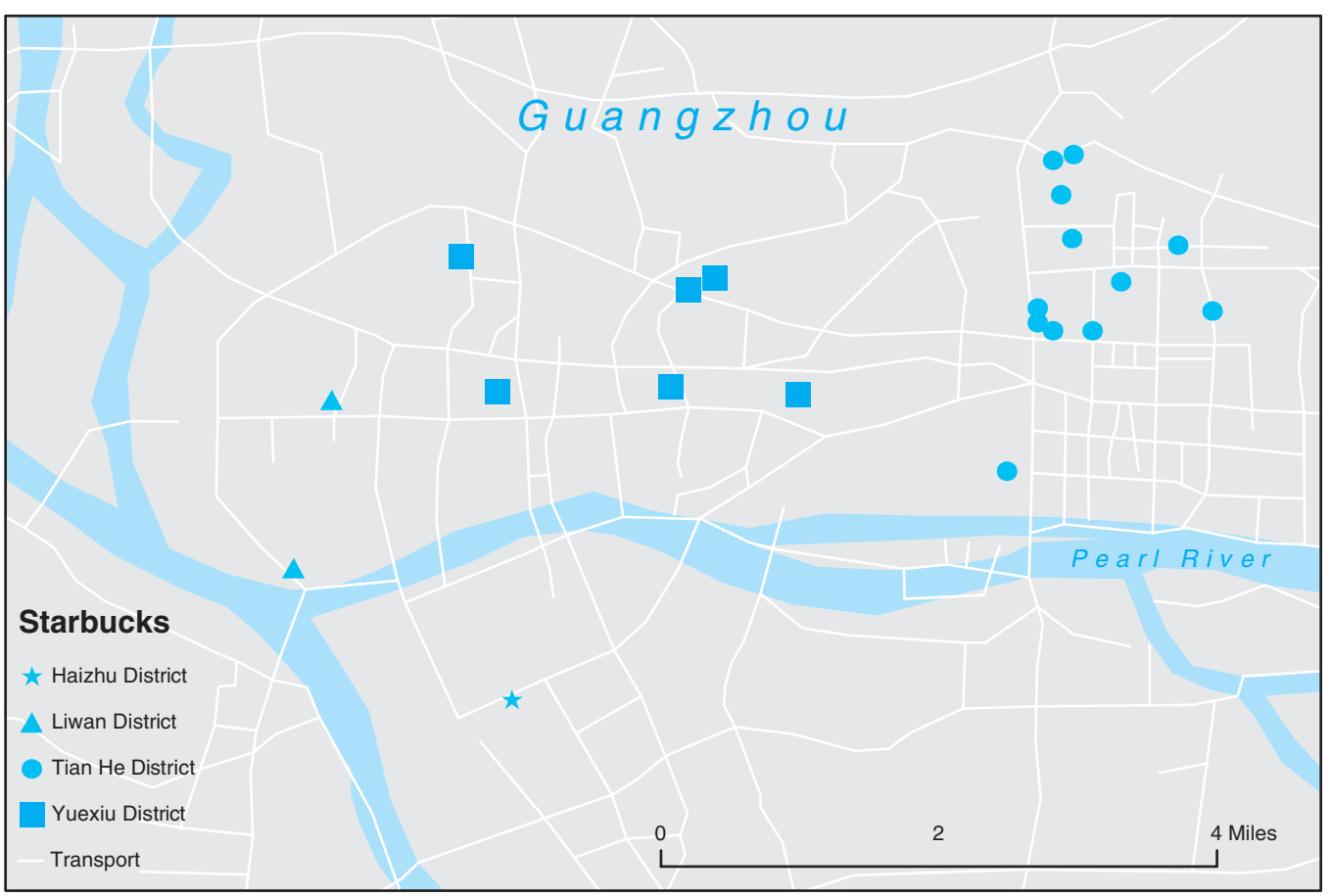


FIGURE 8.29 High amenity zone in Guangzhou, China, around the new Tian He central business district.

TABLE 8.7 Pedestrian Border Crossings from Mexico to the United States, 1997

State and Border Crossing	Number of Incoming Pedestrians
California	
Andrade	1,360,393
Calexico	8,167,540
Otay Mesa	621,517
San Ysidro	8,476,225
Tecate	272,484
Arizona	
Douglas	599,082
Lukeville	76,274
Naco	71,839
Nogales	4,643,538
San Luis	2,220,799
Sasabe	3,097
New Mexico	
Columbus	119,418
Texas	
Brownsville	3,726,740
Del Rio	262,717
Eagle Pass	529,897
El Paso	4,542,646
Fabens	14,737
Hildago	2,429,241
Laredo	5,427,815
Presidio	11,890
Progreso	1,164,483
Rio Grande City	85,919
Roma	443,949
Total	45,272,240

Source: U.S. Customs Service. (1997). Office of Field Operations. Washington, DC: Author.

The following excerpt from an interview with a former resident of the Valley gives a further feeling of the sister city consumer atmosphere:

> Residents of the Valley do not say they are "going to Mexico." They'll either say they are going to Reynosa or Matamoros, or they will simply say they are "going across." I encountered someone from Laredo using this term also. When I lived in Mission from 1989–1990, there were people going across for prescription drugs, which were cheaper in Mexico. I am sure there are more people doing that now as prescription drug prices have increased. I mentioned how US residents go across to shop and that Mexicans do the same thing. Saturday is a very busy day in Downtown McAllen. However, on Sundays the downtown is a virtual ghost town (at least when I was there). The stores weren't open Sundays. There are the Winter Texans, typically Midwesterners who spend the winter in South Texas. Mission, the city where I lived for a year-and-a-half, has many trailer/mobile home parks. They are not the stereotypical trashy trailer parks conveyed through the popular media. These are well-maintained and serve as home for the Winter Texans. (Pinnau, 2003)

This brief example demonstrates the idea of consumer city in a binational context. Even in a poor border region with low levels of education and with increased drug-related crime in the decade since 2000, consumption is growing in importance, and the culture favors international exchange of consumption, especially through the large factor of border shopping.

8.8 THE GEOGRAPHY OF PRODUCER SERVICES

Research on the geography of producer services is not as well established as manufacturing location theory and the research into consumer services, in part because it has risen in prominence in recent decades as manufacturing has declined in relative importance. Coffey (2000) presented several other reasons for why there is relatively little written on the topic:

1. The modern researcher had to contend with the prevailing paradigms that viewed all services as nonproductive activities and that considered those remaining after manufacturing as having been accounted for.
2. Study of producer services had long been confined to the limited framework of central place studies, so it became conceptually stagnant for several decades.
3. Because of the early emphasis on central place studies, more emphasis was placed on consumer services to the exclusion of the more dynamic producer services.

Services represent the largest share of the economy in the United States. The service sector made up 78 percent of the country's private-sector gross domestic product, or $9.7 trillion, in 2008 (Global Services Summit, 2009). A large proportion of this growth was in business services, or what many urban researchers consider to be the heart of producer services. *Producer services* or *business services* represent inputs into the production process of businesses and organizations as opposed to services provided to households or individuals. These typically include activities such as computer services, accounting and bookkeeping services, advertising services, and legal services. Some researchers have broadened the definition of producer services to include finance, insurance, and real estate along with business services (Coffey, 2000). Services also constituted about 25 percent of the value added in manufacturing in 2009 (Global Services Summit, 2009).

Nevertheless, the task of differentiating between consumer services and producer services from census classifications might not be that straightforward. One way to separate the two types of services is to construct an economic input–output model to better estimate the producer–service component of employment (Wernerheim & Sharpe, 2001).

Eventually, researchers recognized the importance of producer services in the role of the city. According to Coffey

(2000), although still framed in the economic-base context, much knowledge was gained on producer services from the 1980s to the mid-1990s, as they were shown to have high export value and thus were seen as a way to promote regional economic growth. Coffey (2000) made note of a surge in research on the decentralization of producer services from downtowns to edge cities.

A study of Atlanta found that suburban downtowns in Atlanta overshadow its CBD in producer services (Fujii & Hartshorn, 1995). Another analysis of Atlanta noted an increase of 200,000 jobs in business and professional services between 1982 and 1997 in the metropolitan area overall, but the central city share dropped by 20 percent (Gong & Wheeler, 2002). Most of the increase occurred in the northern suburbs and could be explained by proximity to a well-educated professional class and highway access. A similar pattern occurred in Montreal (see Figure 8.30), where the relative importance of the CBD with respect to the agglomeration of producer services has declined when compared to edge cities (Coffey & Shearmur, 2002). Their principal argument for this shift to the suburbs is that it reflects an increasing specialization in certain producer services and the subsequent expansion of other high-level services, which the CBD cannot possibly absorb (see Figure 8.31). Thus, the map illustrates the location of these suburban poles relative to the downtown. Many of these suburban poles remain independent of the CBD, as evidenced by weak commuting ties between the two (Shearmur & Motte, 2009).

Producer services are also increasing in Shanghai (Han & Qin, 2009). It is part of the vast restructuring of the largest Chinese cities discussed in this textbook that includes "local economic development, management of rural-urban migration, supply and consumption of land and housing, and integration of cities into the world urban hierarchy" (Han & Qin, 2010, p. 893). Spatial analysis demonstrated that the producer service enterprises are concentrated in a central core area, but are spreading across the metropolitan area. The study indicated three reasons for the spatial distribution of these firms: (1) the historical legacy of Shanghai's colonial era, which emphasized the city center; (2) state planning, which has supported tertiary-sector growth; and (3) market institutions. For the latter, the 21st-century rise in Shanghai's central-city land prices explains a growing movement of producer services to the periphery. The rise in producer services in developing-world megacities such as Shanghai and their differences from those in more economically developed cities need to be included in understanding the worldwide picture.

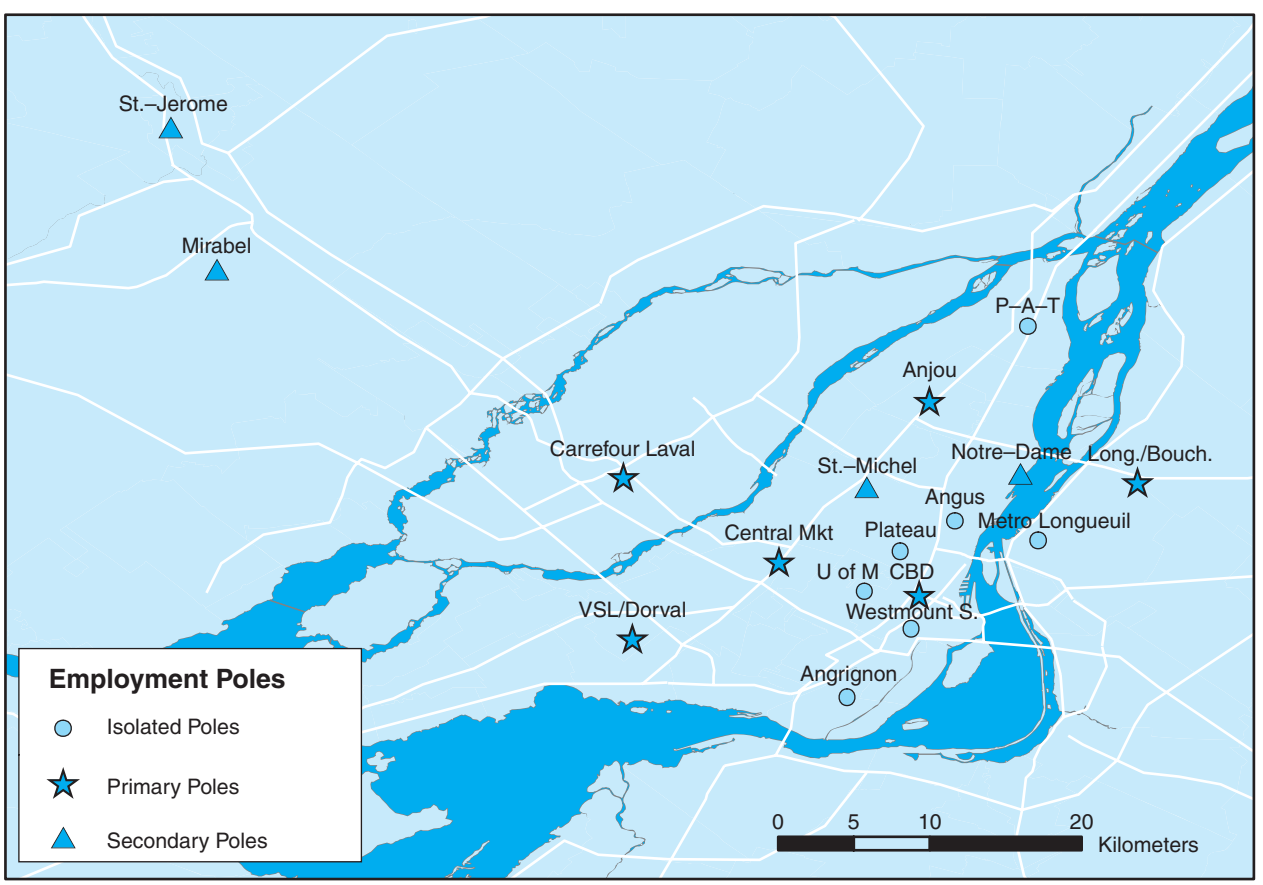


FIGURE 8.30 Montreal employment poles. *Source*: Coffey, W. J., and Shearmur, R. (2002). "Agglomeration and dispersion of high-order service employment in the Montreal metropolitan region, 1981–96." *Urban Studies* 39:359–378. Figure 1, "Employment poles in the Montreal CMA, 1981–96," p. 365.

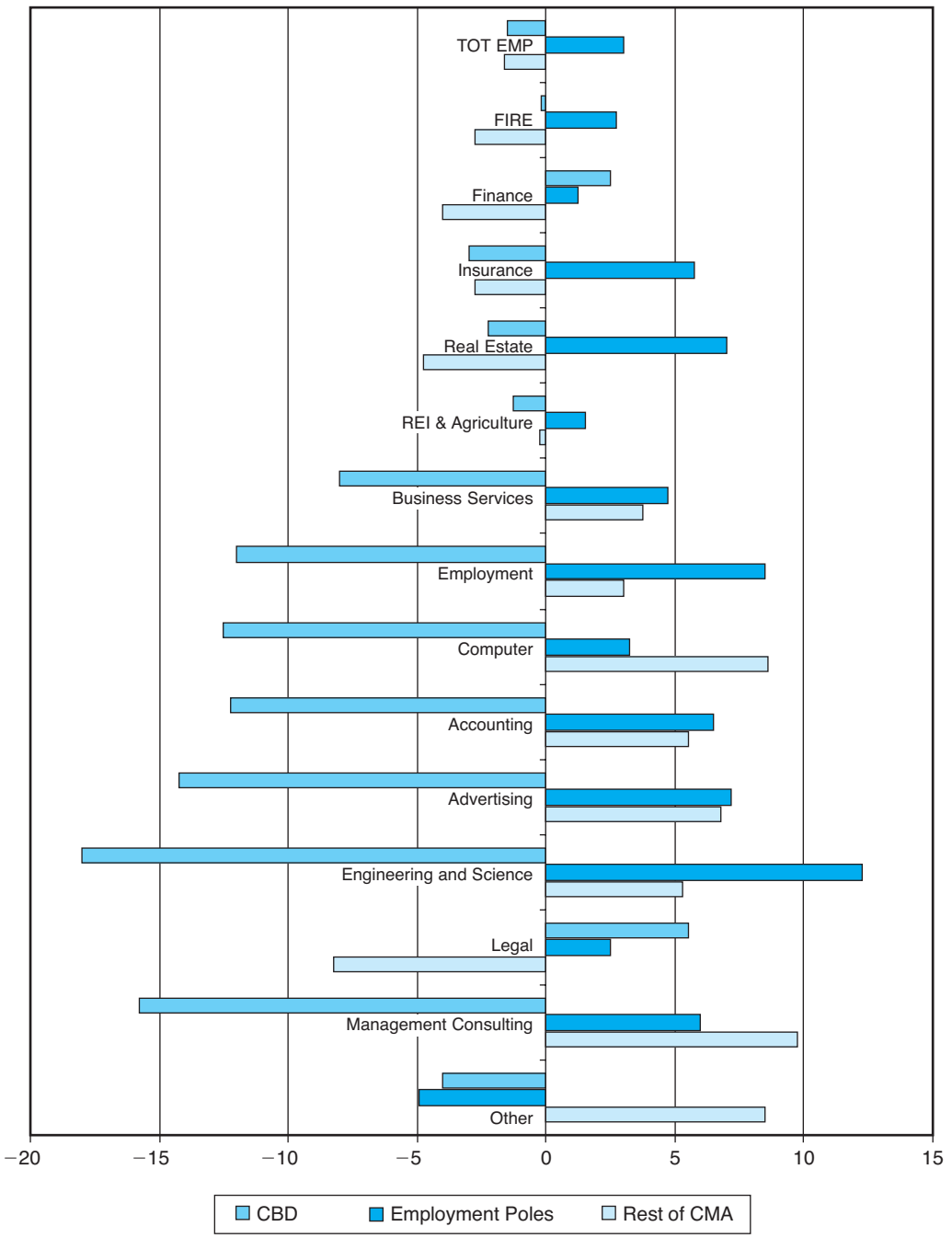


FIGURE 8.31 Changes in the composition of Montreal service employment, 1981–1996.
Source: Coffey, W. J., and Shearmur, R. (2002). "Agglomeration and dispersion of high-order service employment in the Montreal metropolitan region, 1981–96." *Urban Studies* 39:359–378. Figure 4, "Changes in share of CMA employment, Montreal, 1981–96," p. 371.
Note: FIRE = finance, insurance, and real estate; TOT EMP = total employment.
CMA = census metropolitan zone; CBD = central business district.

Summary

This chapter examined industrial location with respect to cities. It covered basic concepts and principles and then moved to the major types of industries in cities. It reviewed the earliest theories on manufacturing location and examined the processes accounting for current-day manufacturing patterns within cities. The chapter then focused on the intrametropolitan location of other economic activities and developed an urban issues section on Chicago. Finally, the chapter turned to the service economy and addressed consumer services, including urban retailing, and producer services.

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Exercise

Exercise Description

Examining clustering of industrial activity of various types for the city of Chicago, using location quotient analysis.

Urban geographers have become increasingly interested in the dispersion of heavy industry away from the central areas of cities. Logistic requirements for manufacturing often dictate that wholesale- and transport-related activity will follow manufacturing. Meanwhile, professional services have become increasingly concentrated in downtown financial districts. Professionals who work in the financial district often live nearby in high amenity zones (HAZs), where the art and entertainment industry is concentrated. In this project, we examine the distribution of establishments in the above four industrial sectors within Chicago to see if the patterns that emerge are consistent with the above statements about the industrial geography of the modern global city.

Background Information

Location Quotient: There are several methods for measuring an area's industrial specialization. The method we use in this project is known as a location quotient (LQ). The LQ expresses the share of establishments in a given industry in a specified subarea as a percentage of the share of establishments in the same industry within the larger area. In this exercise, the subareas are ZIP codes, and the larger area is the city of Chicago.

Let's look at an example using ZIP code X:

	ZIP Code X	City of Chicago
Professional services	8.7%	5.5%
Manufacturing	17.6%	22.8%

To determine ZIP code X's specialization in professional services and manufacturing relative to the city of Chicago, we plug the above percentages of establishments into the following equations:

$$\text{LQ for professional services} = (8.7/5.5) * 100 = 158$$

$$\text{LQ for manufacturing} = (17.6/22.8) * 100 = 77$$

An LQ equal to or greater than 100 indicates that the ZIP code is specialized in that category, and an LQ less than 100 indicates that the ZIP code is not specialized in that category. In this example, the ZIP code is specialized in professional services and not in manufacturing.

The data for this exercise are from the U.S. Census Bureau's 2004 Zip Business Patterns (ZBP). To perform the necessary calculations for the LQ, the city of Chicago's total establishments in the four sectors are required. These figures are shown in the following table:

NAICS Code	Description	Establishments	Sector Establishments Divided by Total City Establishments
31 (31–33)	Manufacturing	3,790	.057
48	Transportation & warehousing	2,155	.032
54	Professional, scientific, and technical services (taxable)	10,125	.152
71	Arts, entertainment, and recreation (taxable)	865	.013

Google Earth Version

Part 1: Edit the City of Chicago Zip Code Establishment Table

1. Start Microsoft Excel, and open the Chp8LQTable.
   This is a spreadsheet of businesses for the 63 ZIP codes in Chicago and its vicinity in 2004. The columns and their meaning are as follows:
   A – Postal (ZIP Code)
   B – Mfg (Manufacturing establishments—NAICS code 31)
   C – Trnswhls (Transportation and warehousing establishments—NAICS code 48)
   D – Profsci (Professional, scientific, and technical services establishments—NAICS code 54)
   E – Art (Arts, entertainment, and recreation establishments—NAICS code 71)
   F – Total Establishments
2. We want to compute the LQ for each of the four business establishment types, so let's add four new column titles:
   Loc31 in cell G1
   Loc48 in cell H1
   Loc54 in cell I1
   Loc71 in cell J1
3. The percentage for the city of Chicago in each of the establishment types is as follows:
   Manufacturing = .057
   Transportation and warehousing = .032
   Professional, scientific, and technical services = .152
   Arts, entertainment, and recreation = .013
   The above percentages are the denominator of the LQ equation. Now let's compute the LQs.
4. In cell G2, enter
   = ((b2/f2)/(.057))*100
   In cell H2, enter
   = ((c2/f2)/(.032))*100
   In cell I2, enter
   = ((d2/f2)/(.152))*100
   In cell J2, enter
   = ((e2/f2)/(.013))*100
5. Copy the above formulas down for the remaining ZIP code records.
   Any LQ value greater than 100 means that the ZIP code is specialized in that industry.
6. Save your spreadsheet.

Part 2: Examine the Location Quotients for Each Industry Type

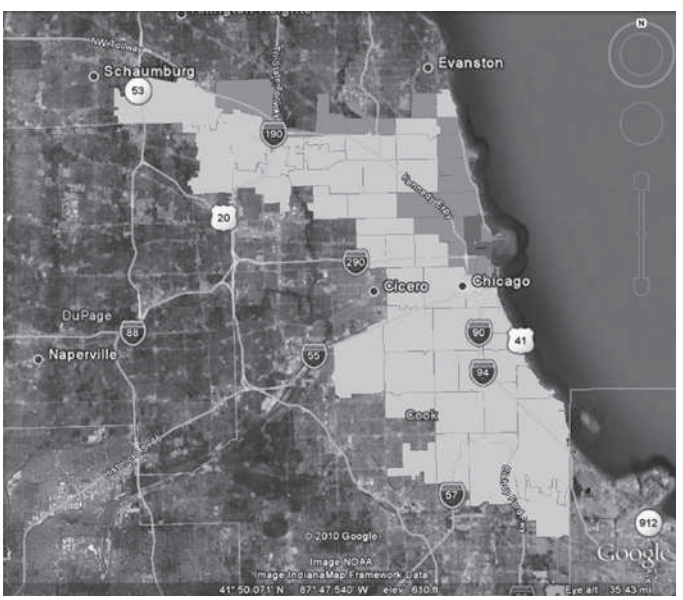
7. Launch the Chapter 8 Google Earth KMZ file by double-clicking it:
   EUC_Ex8.kmz
   It begins with LQ for Manufacturing turned on. The dark blue represents ZIP codes with very high LQ values. Save the map image to turn in with your essay.

(Manufacturing)

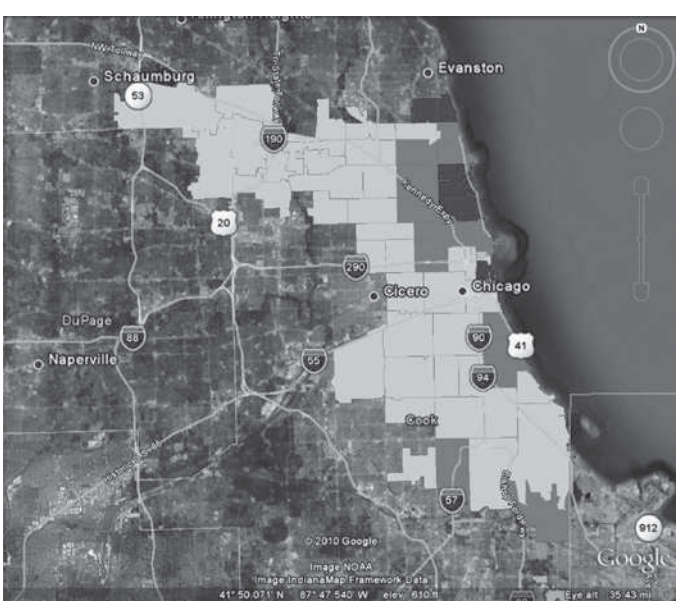
(Transportation and warehousing)

8. Next uncheck Manufacturing, and turn on Transportation and Warehousing. Also save the map image to include with your essay.

9. How similar or different are the overall geographical patterns of the locations of manufacturing and transportation/ warehousing establishments? By comparing the two maps, identify an area that has high levels of both manufacturing and transportation. Examine this area with Street View to demonstrate some examples of the connection between manufacturing and transportation facilities.
10. Use either your spreadsheet or the map to determine a ZIP code with a high LQ for manufacturing or transportation/warehousing, zoom into that community, and find an example aerial view or street view that represents manufacturing or transportation/ warehousing. You will have to turn off the ZIP code maps when you are zoomed in. Save the map image for your example, hand mark the example place or zone you identified, and submit the image with your essay.
11. Repeat the above for professional/scientific/technical services and art/entertainment/recreation establishments, and make sure to save a map image of each to include with your essay.



(Professional/scientific/technical services)



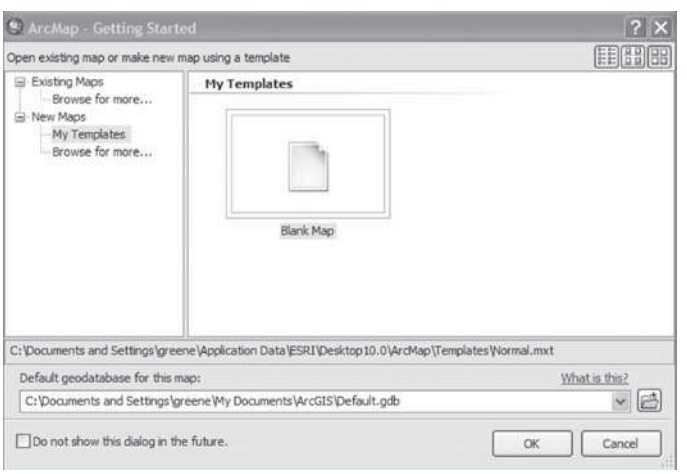
(Art/entertainment/recreation)

Google Earth Short Essay: For each of the four industry categories—manufacturing; transportation and warehousing; professional, scientific, and technical services; and art/entertainment/recreation—use either the Information Points on the map or your spreadsheet information to determine a ZIP code with a very high LQ, zoom into that ZIP code, and find an example aerial view or street view that represents that category. For art/entertainment/recreation and for professional/scientific/technical services, you will likely need to do some searches, such as "Theaters + Chicago" or "Hospitals + Chicago," in order to identify specific examples of structures, blocks, neighborhoods, or community areas in that ZIP code that represent the industry. You will have to turn off the ZIP code maps when you are zoomed in, since they block the satellite imagery. Save the map image for each of your examples, hand mark example places or zones that you have identified (e.g. "theater district"), and submit the images with your essay.

Your essay should summarize, for each of the four industries, where a very high LQ ZIP code is located in the city of Chicago and what is/are specific example(s) of that industry, attaching an annotated map of the ZIP code as needed. You will turn in four additional maps from the exercise showing the citywide LQ patterns for the four industries. Discuss why you think each industry located where it did in the city?

ArcGIS 10 Version

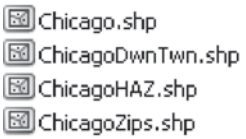
1. Start ArcMap. Under New Maps, click My Templates, and then double-click the Blank Map template.



2. Click Add Data, and navigate to the exercise data folder.

Note: If you do not see the folder where you placed the exercise data, you will need to make a new connection to the root directory that holds the data.

3. Add the following layers from the Chapter 8 folder:
   ChicagoZips.shp (Zip Code Polygons with 2004 Establishment Data)
   Chicago.shp (Chicago City Boundary)
   Downtown.shp (Downtown Chicago Boundary)
   ChicagoHAZ.shp (Chicago's High Amenity Zone Boundary)
   You can add all four at once by clicking one of the file names, then clicking the others while holding down the Ctrl key on the keyboard, and clicking Add.



4. Keep the drawing order as shown above, and click the symbol for Chicago.shp. Click Hollow for the style, and then click the Edit Symbol button. Click Outline to open the Symbol Selector, and choose the city boundary style. Right-click ChicagoZips, and select Zoom To Layer.
5. Right-click ChicagoZips, and select Open Attribute Table.

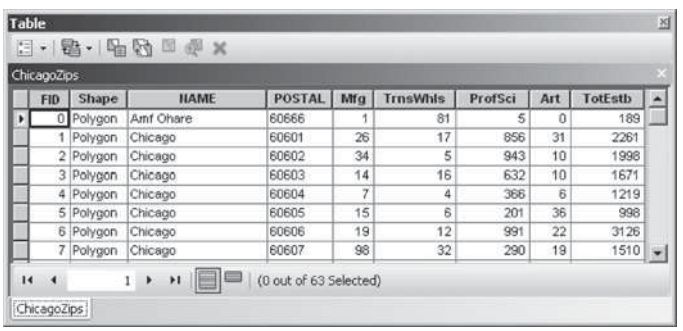


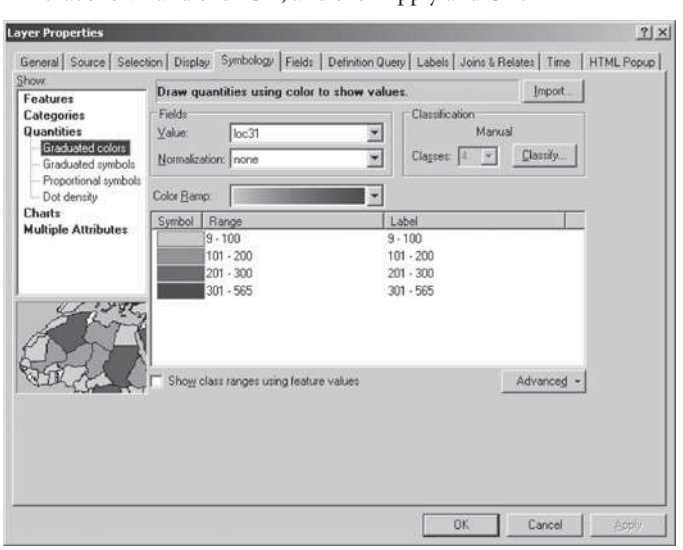
Table
ChicagoZips
FID Shape NAME POSTAL Mfg TrnsWhls ProfSci Art TotEstb
0 Polygon Amf Ohare 60666 1 81 5 0 189
1 Polygon Chicago 60601 26 17 856 31 2261
2 Polygon Chicago 60602 34 5 943 10 1998
3 Polygon Chicago 60603 14 16 632 10 1671
4 Polygon Chicago 60604 7 4 366 6 1219
5 Polygon Chicago 60605 15 6 201 36 998
6 Polygon Chicago 60606 19 12 991 22 3126
7 Polygon Chicago 60607 98 32 290 19 1510
(0 out of 63 Selected)
ChicagoZips

Note the fields for ZIP code, establishments by four industry types, and total establishments.

6. Click Table Options, and add a field for the LQ for manufacturing establishments. Assign the name loc31, type to float, 16 for precision, and 0 for scale.
7. Right-click the loc31 field and calculate (.057 in the denominator is found in the table in the "Background Information" earlier in this exercise):

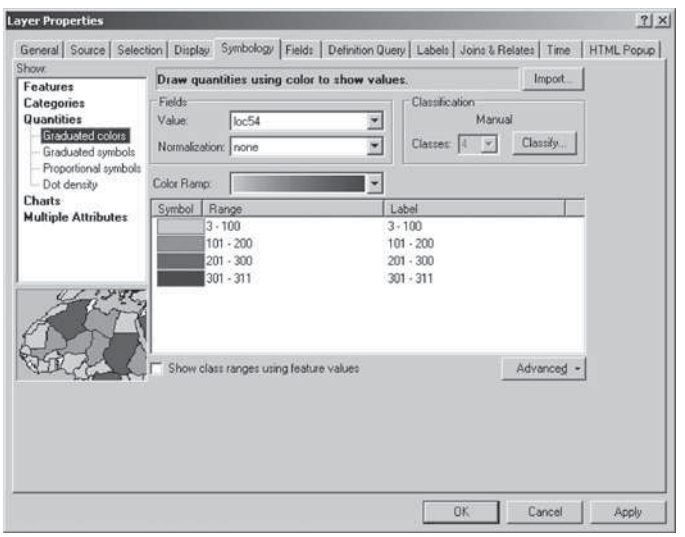
$$(([Mfg]/[TotEstb])/(.057))*100$$

8. Repeat steps 6 and 7 for the remaining industry types by substituting the correct industry name and number for Mfg and loc31. Also, substitute the appropriate number from the table on page 269 in the "Background Information" for the denominator .057.
9. Make a graduated color map for the four industries, using the LQ fields. For instance, to map the LQ for manufacturing, right-click ChicagoZips, and select Properties. On the Symbology tab, under Quantities, select Graduated colors, set the Value field to loc31, change Classes to 4, click Classify, manually change the range to that shown and click OK, and click Apply and OK.

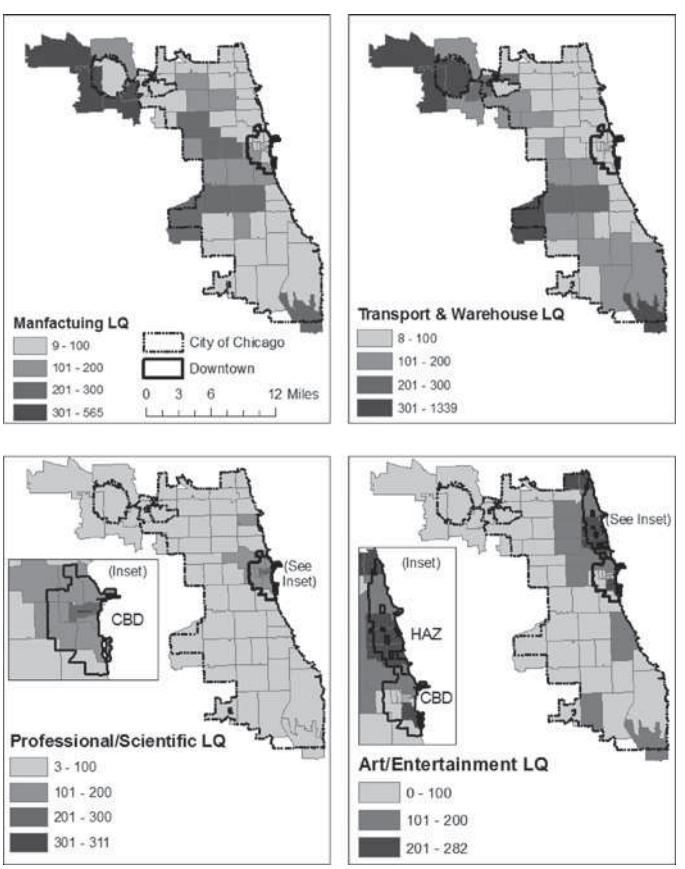


Note: When you change a range, you need to type in only the higher value of the range. For example, for 0–100, you need to type in only 100.

10. To show a second industry (e.g., professional/scientific/technical), right-click ChicagoZips, and click Copy. Then click the Insert Menu, and select Data Frame. Now right-click New Data Frame, and select Paste Layer(s). Copy and paste the three other layers from the above data frame to the new data frame in the same drawing order. Do not forget to zoom to the map extent of ChicagoZips by right-clicking ChicagoZips and Zoom To Layer. Now right-click ChicagoZips, click Properties, change the LQ to loc54, change the ranges to those shown below, and click Apply and OK.



11. Repeat Step 10 for the remaining two industries. Click View, and click Layout View. Compose a layout that shows your four industries. If you would like insets for the CBD and HAZ as shown below, you will have to add two more data frames.



Note: You can size the four map windows by clicking and holding onto the corners of the windows. You can also zoom and position the maps in the windows.

ArcGIS Short Essay: Write a short essay describing the location of the four industry types within the city of Chicago. Explain the shapes and differences in the industry patterns. What are the implications of the patterns for the Chicago economy and its businesses? Refer to the "Background Information" for more detail. Do the patterns match what the literature suggests?

Log in to www.mygeoscienceplace.com for ArcGIS Exercise data files, Google Earth™ Exercise kmz files, RSS feeds, flashcards, web links, and self-study quizzes to enhance your study of industrial location and cities.

CHAPTER

9 Urban Core and Edge City Contrasts

The physical pattern of urban development has been a focus of urban geography for a long time. *Urban morphology* is the subdiscipline of urban geography that specifically examines the physical layout of cities. It is a more detailed study of the physical layout of cities than the urban structure models presented in Chapter 3. In contemporary times, urban morphologists and other urban scholars have been preoccupied with the increasing rate at which development has spread over vast areas, often spatially fragmented, a characteristic often referred to as *urban sprawl*. The rise of urban sprawl has been blamed for a growing number of urban ills such as traffic congestion, the demise of the town center, a reduction in access to employment, the loss of a sense of community belonging, and the loss of prime farmland, to name just a few. Because the topic of sprawl involves the process of development spreading out over space, geographic information system (GIS) techniques are being used by a variety of federal, state, and local governments to help them understand the pace and pattern of this phenomenon, as well as to help them develop alternative planning scenarios.

A root cause of sprawl is the decentralization of people and jobs from urban cores to the suburbs, a topic that has especially occupied the attention of urban geographers in the last 50 years. Both housing and employment growth and redistribution have occurred in suburban areas to such an extent that many metropolitan areas are now *polycentric*—they have multiple downtowns. One concomitant of this trend was that, between 1993 and 1996, employment growth in suburban areas exceeded employment growth in downtowns in all but 20 percent of the largest metropolitan areas in the United States (Brennan & Hill, 1999), and that between 1986 and 1998, more than 80 percent of the new housing construction in the United States took place in the suburbs (Hoffman, 1999).

This chapter considers the geography of sprawl, its root causes, and its multiple forms. First, the relative trends of central-city and suburban change are reviewed. We then consider the topic of urban sprawl with a case study analysis of the Chicago region, which is linked to the GIS exercise at the end of the chapter. Another section examines the metropolis of Sydney, Australia, which falls between two extreme international models of sprawl. The impact of transportation on the form of urban sprawl is also analyzed in the context of a four-stage model of influence. A comparison of Chicago and Los Angeles shows the relationship of population growth to transportation developments from 1960 to the present.

Following the discussion of sprawl, the concept of edge cities, including their delineation and measurement, is introduced. An edge city is a center of employment on the outskirts of the urban area, associated with highways. Because edge cities represent alternative employment hubs to the main downtown, they play an important role in the future direction and growth of sprawl. The planning concept of "smart growth" is introduced. The chapter finishes by looking at an example of government planning in response to sprawl—Portland's urban growth boundary.

9.1 CENTRAL CITIES

In the United States, in the second quarter of the 20th century, the populations of large central cities began to spill beyond their borders in large numbers. The 1970 Census was the first in which the number of residents of suburbs surpassed the number of residents of central cities. Since 1910, the proportion of metropolitan area populations living in central cities has declined every decade, although it leveled off somewhat in the 1980s.

In many respects, the 1980s represented a departure from the big-city declines experienced directly after World War II. In many big northeastern and midwestern cities, perennial population declines slowed in the 1980s from the losses experienced in the 1950s, 1960s, and 1970s (see Figure 9.1). For instance, population loss in St. Louis's central city accelerated from the 1950s to the 1960s

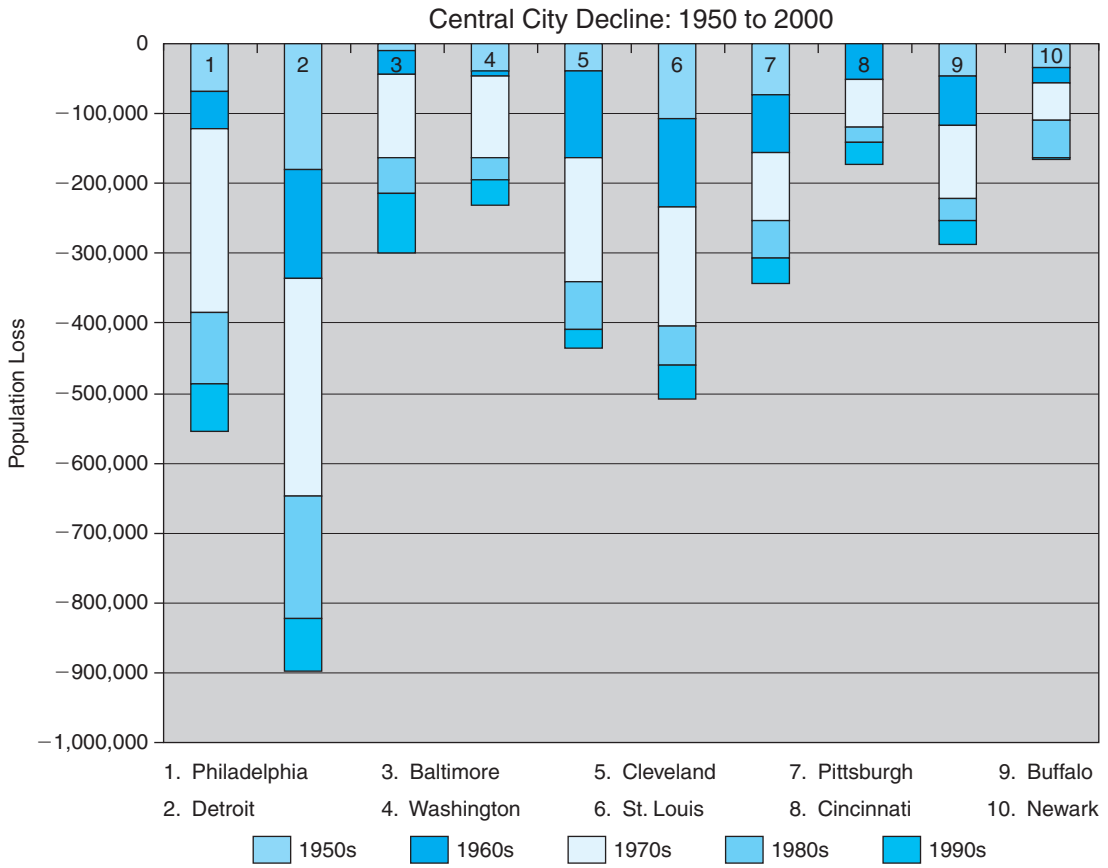


FIGURE 9.1 Central-city decline, 1950–2000, for selected large central cities. *Source:* U.S. Censuses of 1950 to 2000.

and again in the 1970s, when it reached its largest decennial loss of 169,435 persons. However, in the 1980s and 1990s, St. Louis's central-city population decline slowed significantly, amounting to 56,116 and 48,496, respectively. In the 1990s, these perennially declining cities had losses ranging from a low of 1,675 in Newark, New Jersey, to a high of 84,860 in Baltimore. Baltimore's 1990s loss was twice that of the 1980s, but smaller than the loss of 119,046 it experienced in the 1970s.

On the other hand, many cities in the South and West continued to grow from 1950 through the 1980s. In the 1990s, those hemmed in on their edges by other municipalities or natural features leveled off or grew slowly, whereas those that were not inhibited from annexing (e.g., Phoenix and San Antonio) continued to grow at a fast pace (see Figure 9.2). Annexing can be decreased or halted because of physical limitations, limited political interest by the city, and lack of interest or resistance by its target cities or unincorporated areas. For example, Atlanta is not completely hemmed in, but it has not undertaken significant annexation since 1952. Many cities in Texas and Oklahoma have extensive boundaries because they want to prevent population clusters from incorporating and blocking their future expansion. Another factor that might be influencing annexation growth is the relative strength of the metropolitan government. If it is strong, there might be less pressure to annex, such as has been seen in Miami.

The 1990s saw the relative decline of the central city persist in some large metropolitan areas, but not in others. For instance, the central cities of Detroit and Philadelphia experienced changes of −7.5 percent and −4.3 percent, respectively, whereas their overall metropolitan growth rates were 5.1 percent and 4.7 percent. For 2000–2008, their central cities changed by −4.1 percent and −4.6 percent, respectively, while the Detroit metropolitan area changed by −0.6 percent and the Philadelphia metropolitan area grew by 2.7 percent (see Table 9.1). This difference in growth rates between central city and overall metropolitan area indicates that the declining trend of central cities has continued over the most recent two decades in both Philadelphia and Detroit.

On the other hand, the central city of Chicago expanded in population between 1990 and 2000 for the first time since the 1950 Census, although it dropped slightly for 2000–2008. Nevertheless, such population turnarounds do not necessarily return the central city back to the days when it represented the principal location for metropolitan residents, as symbolically demonstrated by the vibrancy of the center of Seattle (see Figure 9.3, page 276). The Chicago metropolitan area population increased in the 1990s by 11.2 percent, which is much higher than the central city's growth rate of 4.0 percent, due in part to the continued growth of metropolitan Chicago's edge communities. As seen in Figure 9.1, the city reverted to a decline of 1.5 percent between 2000 and 2008, although the metropolitan area continued to grow by 5.2 percent (U.S. Census Bureau, 2010). Metropolitan Chicago's growth over the past two decades has been stimulated by the large influx of Hispanics.

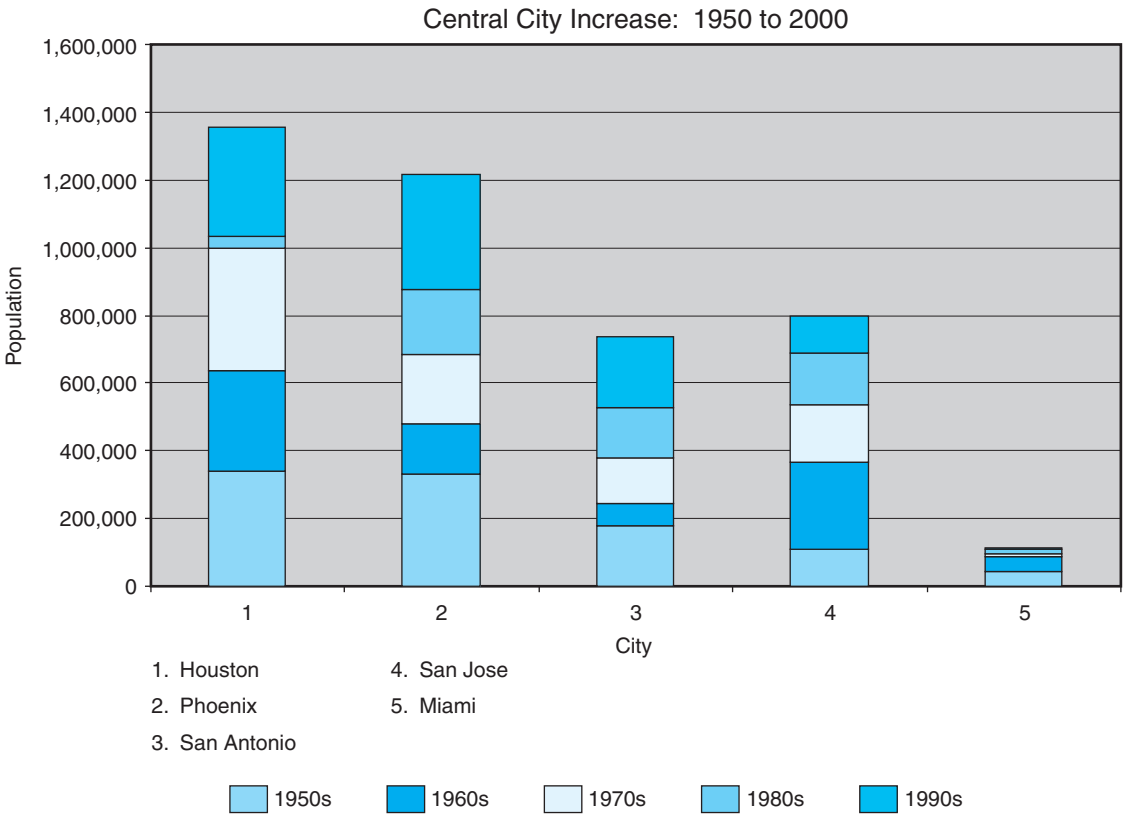


FIGURE 9.2 Central-city increase, 1950–2000, for selected large central cities.

TABLE 9.1 Population Change for the 12 Largest Metropolitan Areas and Cities, 2000–2008

	Population, April 1, 2000	Population, July 1, 2008	Percentage Change, 2000–2008
12 Largest Metropolitan Areas			
New York–Northern New Jersey–Long Island, NY–NJ–PA	18,323,000	19,007,000	3.7
Los Angeles–Long Beach–Santa Ana, CA	12,366,000	12,873,000	8.1
Chicago–Naperville–Joliet, IL–IN–WI	9,099,000	9,570,000	5.2
Dallas–Fort Worth–Arlington, TX	5,162,000	6,300,000	22.1
Philadelphia–Camden–Wilmington, PA–NJ–DE	5,687,000	5,838,000	2.7
Houston–Sugar Land–Baytown, TX	4,715,000	5,728,000	21.5
Miami–Fort Lauderdale–Pompano Beach, FL	5,008,000	5,415,000	8.1
Atlanta–Sandy Springs–Marietta, GA	4,248,000	5,376,000	26.6
Washington–Arlington–Alexandria, DC–VA–MD–WV	4,796,000	5,358,000	11.7
Boston–Cambridge–Quincy, MA–NH	4,392,000	4,523,000	3.0
Detroit–Warren–Livonia, MI	4,453,000	4,425,000	−0.6
Phoenix–Mesa–Scottsdale, AZ	3,252,000	4,282,000	31.7
12 Largest Cities			
New York	8,009,000	8,364,000	4.4
Los Angeles	3,695,000	3,834,000	3.8
Chicago	2,896,000	2,853,000	−1.5
Houston	1,974,000	2,242,000	13.6
Phoenix	1,322,000	1,568,000	18.6
Philadelphia	1,518,000	1,447,000	−4.6
San Antonio	1,160,000	1,351,000	16.5
Dallas	1,189,000	1,280,000	8.1
San Diego	1,223,000	1,279,000	4.6
San Jose	896,000	948,000	5.9
Detroit	951,000	912,000	−4.1
San Francisco	777,000	809,000	4.2

Source: U.S. Census Bureau, *Statistical Abstract of the United States: 2010.* Washington, DC: Author.

FIGURE 9.3 Seattle skyline.

The ramifications of the large central-city declines are significant. In extreme cases, as population decentralizes from metropolitan central-city areas to their suburban edges, urban infrastructure in the central city becomes underutilized or even abandoned. The abandonment of the urban core by the middle class has even been linked to a rising urban underclass, as illustrated in Chapter 7. A later section shows that many owners of industries and businesses in the inner city are also relocating to the suburbs and edge cities, taking with them valuable urban resources and helping contribute to a cycle of central-city decline. When capital and investment are redistributed from the urban core to the suburban periphery, the metropolitan settlement fabric is redefined:

> The replacement for an obsolete building has almost certainly been in another block, another part of the metropolis, or another region of the country. Cost and sheer mechanical inconvenience, as well as changing locational advantages, have usually discouraged replacement of obsolete structures on site. . . . In this process, the nation is not simply replacing an inventory of buildings. Because of changed locational advantages, it is also replacing the major part of the fabric three generations have taken for granted as the bedrock geographic pattern of American settlement. (Borchert, 1991, pp. 233–235)

As Borchert (1991) so aptly described, much of our urban infrastructure, heretofore taken for granted, could be lost as locational advantages shift outward. In the next section, we turn to the topic of urban sprawl, one of the consequences of a tendency in many cities for population to redistribute from the core to the edge.

9.2 URBAN SPRAWL

Urban growth is not new; however, a number of urban studies scholars have become concerned that the quickening rate of this expansion is inefficient and unsustainable. Whyte (1956) referred to this process early on as *urban sprawl,* and the term has continued to be used widely through the current day. Urban sprawl, shown in Figure 9.4, was advanced to a national policy concern in the 1980s and continues as such today. For instance, Al Gore included the issue as part of his Democratic platform in the 2000 election by advocating incentives to stimulate construction within central cities (Kriz, 1999). Likewise, the Obama administration urban policy stresses well-justified investments in impoverished parts of the central city. There are countless examples of local and regional initiatives that have arisen in recent years to curtail sprawl as well. These initiatives include taxpayers giving approval to their local governments to purchase private land for open space, the creation of purchase of development rights (PDR) programs, and the creation of various regional- and state-level land use controls. An example, Portland's urban growth boundary, is covered at the end of the chapter, and these other initiatives are more fully examined in Chapter 11.

The name Levittown has become associated with urban sprawl because it was implemented early in the post–World War II cycle of suburbanization and is well recognized as having perhaps

FIGURE 9.4 Urban sprawl in Las Vegas. *Source:* © Iofoto/Shutterstock.

the greatest impact on the design of American suburbs in this period. William Levitt (see Figure 9.5) built the first Levittown in 1947 on former Long Island potato fields 25 miles east of Manhattan. This automobile-oriented, mass-produced subdivision was extremely attractive to returning veterans and their growing families. Eventually growing to 17,400 houses and 82,000 residents, Levittown became the largest housing development built by a single developer (Jackson, 1985). Levittown was especially successful because it represented all the ideals of the American dream, a single-family house with a yard at low cost:

> The typical Cape Cod was down-to-earth and unpretentious; the intention was not to stir the imagination, but to provide the best shelter at the least price. Each dwelling

FIGURE 9.5 Bill Levitt. *Source:* Time.Com.

FIGURE 9.6 Levittown, Pennsylvania. *Source:* AP Wide World Photos.

> included a twelve-by-sixteen-foot living room with a fireplace, one bath, and two bedrooms (about 750 square feet), with easy expansion possibilities upstairs in the unfinished attic or outward into the yard. Most importantly, the floor plan was practical and well designed, with the kitchen moved to the front of the house near the entrance so that mothers could watch their children from kitchen windows and do their washing and cooking with a minimum of movement. Similarly, the living room was placed in the rear and given a picture window overlooking the back yard. This early Levitt house was as basic to post–World War II suburban development as the Model T had been to the automobile. In each case, the actual design features were less important than the fact that they were mass-produced and thus priced within the reach of the middle class. (Jackson, 1985, pp. 235–236)

Two more Levittowns were built—Levittown, Pennsylvania, in the 1950s in Bucks County near Philadelphia (see Figure 9.6) and Levittown, New Jersey, in the 1960s also outside Philadelphia. To the critics of this new suburban style, the Levittown developments became synonymous with mass-produced, bland housing (see Figure 9.7).

Critics claim that the shift of population from city to suburb coincided with the expansion of low-density *single-use* developments (i.e., subdivisions with single-family housing only) with *leap-frog* tendencies (i.e., tendencies to bypass less desirable

FIGURE 9.7 Suburban family and their Levittown home in the 1950s. *Source:* Getty Images.

parcels closer in) and isolated strips of commercial development that are served only by automobiles. The problems associated with this form of development included the following:

- Loss of open space, including some prime farmland (Platt, 1991);
- Disruption of natural habitats (Acevedo & Buchanan, 2000);
- Traffic congestion as a result of the increased separation of commercial land uses from residential land uses (Downs, 1992);
- Diminished air quality as a result of increased vehicle-miles traveled, as evidenced by the number of urban ozone alerts issued in major metropolitan areas (National Research Council, 1995); and
- Widening socioeconomic disparities as a result of selective migration from the inner cities to the suburbs (Powell, 1998).

Mieszkowski and Mills (1993) identified two groupings of theories designed to explain the causes of suburbanization. Urban theorists and transportation scholars favor the *natural evolution theory*. This theory, which draws from the work of Alonso (1964), holds that residential location choices are determined by minimizing commuting costs to the central business district (CBD). The theory recognizes that central areas are developed first. As land close to the center becomes filled in, development moves to more open tracts of land, likely to be in the suburbs. As new housing is built at the periphery, persons in higher-income groups who can afford larger and more modern housing tend to move outward to this area. As a trade-off for the longer commute, the homeowner is rewarded with lower housing prices and a larger lot farther from the CBD.

The second grouping of theories (the *fiscal–social problems approach*), in contrast, emphasizes fiscal and social stresses of the central city as the main impetus for suburbanization. Ironically, these stresses are a result of suburbanization itself because, as the middle class leaves the inner city for the periphery, it leaves behind a decaying area that the parent city finds more difficult to maintain with a falling tax base. The desire to leave these declining neighborhoods grows, resulting in a repeating cycle of poorer school districts and rising racial tensions, crime, congestion, and environmental degradation. The middle-class movers arriving in affluent suburbs might actually lower the per capita income there.

Some urban historians suggest that the federal government has contributed to inducing sprawl through the mortgage insurance programs of the Federal Housing Administration (FHA), begun in 1934, and the Veterans Administration (VA), begun in 1944. These programs provided the funds that allowed many Americans to afford home loans (Hanchett, 2000). However, 1990s data did not show a bias in mortgage loans toward the suburbs. Almost half (46 percent) of FHA's single-family loans in 1996 were made for homes located in central cities (General Accounting Office, 1999).

Even more important to the federal government's leading role in contributing to sprawl was the passage of the 1956 Federal Interstate Highway Act. The interstate highway system eventually reached 42,500 miles, with the federal government paying 90 percent of the cost (Jackson, 1985, p. 249). Although now almost 100 percent complete, more recent expansion of federal highway capacity took place at the urban fringe, which often is expanding in population (National Research Council, 1995, p. 194). Not only did these highways make it convenient for people to leave the city, but also a further profound impact was to make it more advantageous for industry to locate outside the city around suburban superhighway interchanges for superior logistical access.

It is important to note that not all urban scholars are critical of suburbia. For instance, Richardson and Gordon (2004) contended that many of the arguments of the antisprawl coalition are flawed. For instance, on the issue of sprawl's impact on traffic congestion, they stated that:

> Most people live and work in the suburbs, and most commuting is suburb to suburb. Moreover, our highly mobile population relocates to economize on trips in response to congestion, resulting in the "commuting paradox," where increasing route congestion is compatible with stable or shorter travel times. Average commuting speeds keep rising. The U.S. Department of Transportation reports that average speeds were 28.0 m.p.h. in 1983, 32.3 m.p.h. in 1990, and 33.6 m.p.h. in 1995. Distances are increasing, but trip times have changed little because more trips take place on less congested suburban roads. Where there truly is congestion, it could easily be ameliorated by road-user pricing, where motorists pay to drive on freeways at peak times of the day. Suburbanization is a traffic safety valve, more of a solution than a problem. In fact, the worst traffic and dirtiest air are found in the highest density areas. (Gordon & Richardson, 2000, p. 68)

Others have taken issue with Gordon and Richardson on decreasing travel times in the suburbs:

> Even on their own terms, G & R's macro comparisons are suspect. In one paper after another, they have argued that decentralization of firms and households raises average travel speeds enough to compensate for longer trips. Recent evidence suggests otherwise. Average commute times became worse during the 1980s in 35 of the 39 metropolitan areas with more than one million people. By the end of the decade, average commute times were significantly greater in the suburbs than in central cities. (Ewing, 1997, p. 113)

Horner (2004), in a review of the commuting literature, saw no signs of congestion abating any time soon. Nevertheless, the question of changes to suburban commuting remains unresolved. It would be closer to solution if more data were available. The true answer might vary from one metropolitan area to another. Sprawl has been evident worldwide. Gilli (2009) examined sprawl in the Paris, France, metropolitan area from 1975 to 2006. He found that jobs tended to become more sprawled over time. In 2006, the central city had not lost its dynamism; jobs were "half sprawled and half agglomerated," without loss of job sectoral diversity in outlying areas (Gilli, 2009, page 1412).

9.3 TRENDS IN URBAN DEVELOPMENT RATES

Although there is debate among researchers over the significance and impacts of sprawl, there is much evidence to suggest

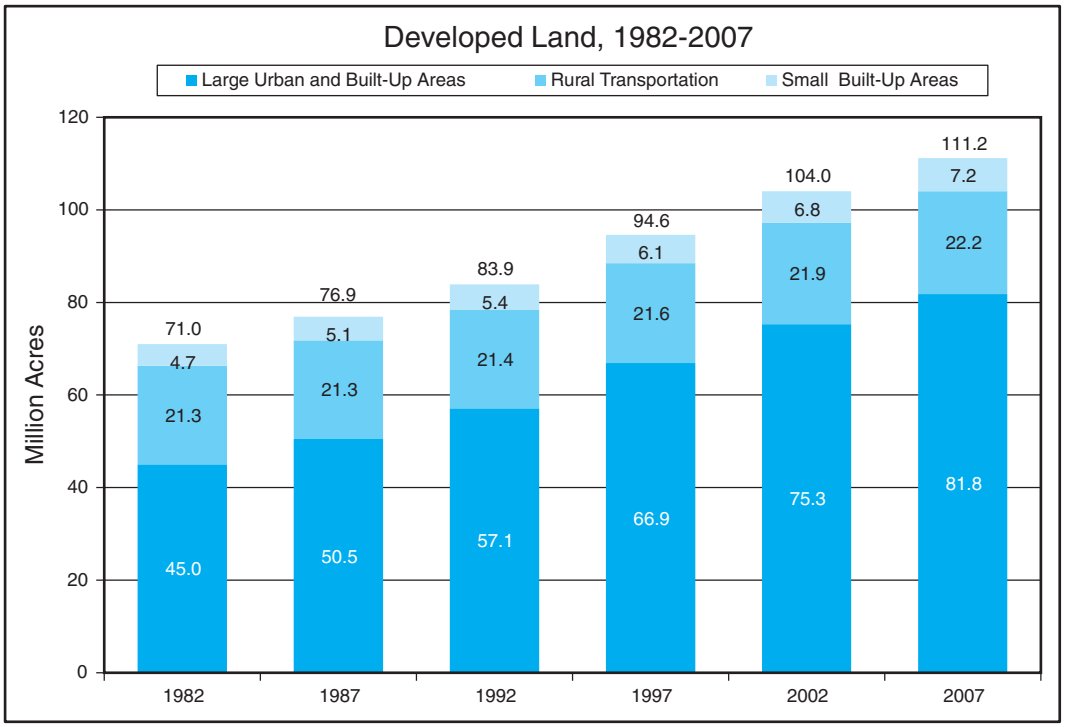


FIGURE 9.8 Developed land in the United States, 1982–2007. *Source:* U.S. Department of Agriculture (2009). Summary Report: 2007 National Resources Inventory, Natural Resources Conservation Service, Washington, DC, and Center for Survey Statistics and Methodology, Iowa State University, Ames, Iowa. Figure on Developed Land, 1982–2007, p. 7. Available at http://www.nrcs.usda.gov/technical/NRI/2007/2007_NRI_Summary.pdf

that sprawl is continuing unabated at faster rates than in the past. One source of information on the amount of urban and developed land is the National Resources Inventory (NRI), which, until recently, was conducted by the Natural Resource Conservation Service of the U.S. Department of Agriculture every 5 years, or more recently annually, on a large sample of land units throughout the United States. When those results were combined with the previous results, it estimated that the nation's 73 million acres of urban and built-up land in 1982 grew to 111 million acres in 2007, an increase of 40 million acres, or a 56 percent increase, over the 25-year period (see Figure 9.8).

What is especially noteworthy in the NRI data is the rising annual rate of urban development. On the basis of the 25-year period, U.S. residents added an average of 1.6 million acres of urban land every year between 1982 and 2007 (see Table 9.2). The rate was especially high during the 1992–1997 and 1997– 2002 year observation periods, when U.S. residents added 2.1 and 1.9 million acres per year of new urban land, respectively. The latter provides credibility to the argument that the form of urban development today is more land consuming than during previous development periods. The most recent 2002–2007 observation period shows a lowering to 1.4 annual rate of change, but the housing slowdown that helped trigger the 2007–2009 recession was already underway at the end of this period. Lopez and Hynes (2003) developed a sprawl index and found a similar increase in land consumption up through the year 2000. To demonstrate the variability of views on this issue, the next section, "Analyzing an Urban Issue: Urban Sprawl, Its Measurement, and Its Impacts," examines the topic at length. One aspect of this urban issue, the forever-changing urban fringe, is the study objective of this chapter's GIS laboratory exercise.

TABLE 9.2 Rate of Annual Increase of Urban Land (millions of acres), 1982–2007

1982 to 1987	1987 to 1992	1992 to 1997	1997 to 2002	2002 to 2007
1.2	1.4	2.1	1.9	1.4

Source: U.S. Department of Agriculture. (2009). Summary Report: 2007 National Resources Inventory, Natural Resources Conservation Service, Washington, DC, and Center for Survey Statistics and Methodology, Iowa State University, Ames, Iowa. Figure on Developed Land, 1982–2007, p. 7.

9.4 ANALYZING AN URBAN ISSUE: URBAN SPRAWL, ITS MEASUREMENT, AND ITS IMPACTS

During the early 1970s, Clawson compared the patterns of urban development in Britain and the United States and made the following observation about the American pattern: "The characteristic development form of the postwar United States has been a series of separate subdivisions, with intervening tracts of open land, spreading away in all directions from the larger urban areas" (Clawson & Hall, 1973, p. 130). Clawson's observations not only capture the essence of the term *sprawl,* but also describe a key feature of urban areas known as the urban–rural fringe. Urban sprawl is land use typified by dispersed, automobile-dependent development outside compact urban centers (Sierra Club, 2010). It is characteristically low-density settlement, often in erratic building patterns, located

along highways in formerly rural areas, and consuming excessive amounts of land. As the name implies, the *urban–rural fringe* is where the zone of urban land is ending and that of rural land is beginning, although no single line separates the two.

More recently, the urban–rural fringe was described as a peri-metropolitan bow wave:

> The bow wave is a standing wave that always remains immediately in front of the bow of a ship moving through water. The urban–rural fringe, then, is the bow wave of the built-up area of the city, the zone of intensively cultivated, high-priced agricultural land that remains immediately in front of the expanding urban edge. (Hart, 1991, p. 36)

Although Hart was using the bow-wave analogy to argue that the high price of agricultural land in this zone was due to its location, rather than the quality of the soil, the analogy has broader significance, showing the urban–rural fringe as highly dynamic and not capable of being delineated precisely, as a "snapshot" of the fringe at one point in time is hard to achieve. This exercise utilizes this bow-wave idea, but instead of using it for agricultural land, it applies the concept to the expanding and developing metropolitan growth rings of Chicago during the period from 1960 to 2000.

Evidence supporting the bow-wave analogy can be seen in recent growth trends for Chicago (see Figure 9.9). Similar to Hart's (1991) case study of agricultural production occurring

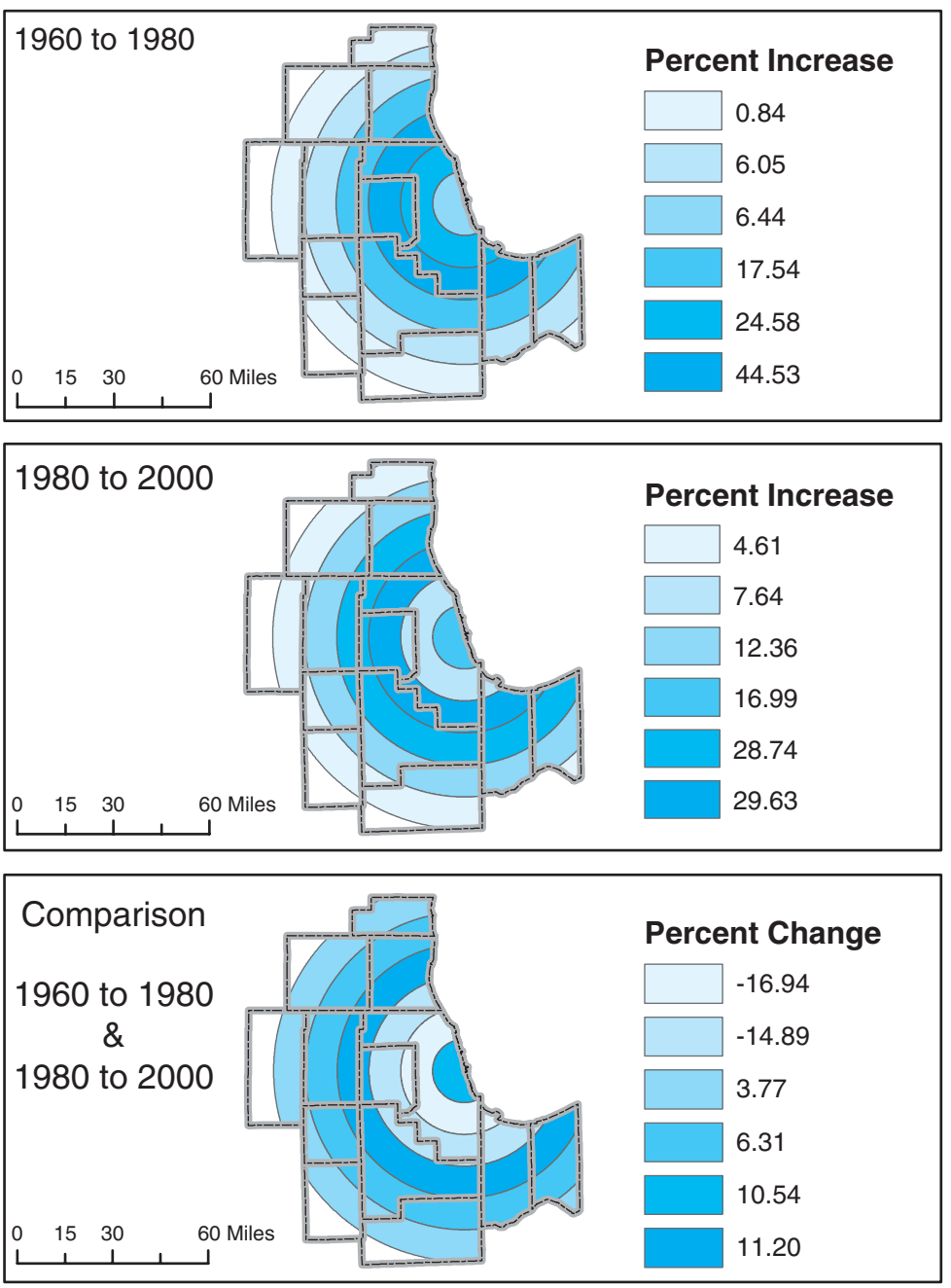


FIGURE 9.9 Growth rings around downtown Chicago, 1960–2000.

TABLE 9.3 Chicago Ring Analysis of Population Increase for Two Time Periods

	1960 to 1980		1980 to 2000		Difference
	Total	Percent	Total	Percent	Change in Percentage
Ring 1	132,448	6.45	303,417	16.99	+10.54
Ring 2	505,229	24.58	136,482	7.64	−16.94
Ring 3	915,004	44.52	529,055	29.63	−14.89
Ring 4	360,550	17.54	513,073	28.74	+11.20
Ring 5	124,404	6.05	220,785	12.36	+6.31
Ring 6	17,271	0.84	82,406	4.61	+3.77

Note: Percent derived by dividing total growth in the ring by total growth in the region, with total regional growth of 2,054,906 between 1960 and 1980 and 1,785,218 between 1980 and 2000.

in rings leading outward from New York City, rings (10 miles in width) were generated out from downtown Chicago. Census tracts were identified as growth ones for the period between 1960 and 1980 or between 1980 and 2000 and were included as long as they had a base year population greater than zero and increased in population. For each ring, the proportion of the ring's total population in these growing census tracts was then computed (see Table 9.3). Considering the first time period, 1960 to 1980, the ring that contained the greatest share of residents living in growing tracts was Ring 3 (Figure 9.9), at nearly 45 percent. We can place the center of the late-1970s-to-early-1980s fastest-growth ring somewhere in central DuPage County, about 30 miles due west of downtown Chicago.

The pattern that emerged in the second growth period, 1980 to 2000, is more complex, mainly because the inner core's share of residents living in growing tracts increased from less than 1 percent between 1960 and 1980 to 17 percent. In this exercise, the inner core refers to the innermost growth circle, referred to in the tables as Ring 1. Much of this increase actually occurred in the 1990s, during which time the city of Chicago experienced its first reversal of population decline since the 1950 Census. Another trend observed in the data is that the fourth growth ring increased its share of total metropolitan growth from 19 percent in the first growth period to 29 percent by the second growth period. Meanwhile, the third ring, although accounting for a 29 percent share of growth, was significantly down from its earlier 44 percent. The full story is told in the third map of the sequence, where the fourth ring, 30 to 40 miles from downtown, was the latest locus for the region's fastest growth. This fourth ring, centered in eastern Kane County, was bounded to the east by two growth rings declining in significance. The true urban fringe or bow wave was probably in Ring 5 or Ring 6, just to the west of the high-growth Rings 3 and 4, where the share of population living in growing tracts was also increasing, but where densities were lower and the prevalence of half-acre lots or larger was consistent with the densities of the urban–rural fringe (Heimlich & Anderson, 2001). Future growth will be dictated in part by local land-use policies; for instance, Kane County's Ring 5 is in an area where the county's Forest Preserve District is purchasing land for conservation, which could result in less fragmentation and more clustering of development (Skibbe & Miller, 2008).

The urban–rural fringe as peri-metropolitan bow wave raises heated debate on a number of issues. Key among these is the impact of urban expansion on farmland and especially the loss of prime farmland. Greene (1997) studied the Kane County portions of Ring 4 and Ring 5 within the Chicago study area and found that, as they were urbanizing, their agricultural land was reduced from 73 percent to 49 percent of their total area between 1975 and 1990. Moreover, the agricultural land that was lost was overwhelmingly prime farmland (see Figure 9.10). Like many other large midwestern cities, Chicago, on its western side, adjoins the largest belt of prime farmland in the nation. Thompson and Prokopy (2009) used more recent farmland conversion data to study all of Illinois and Indiana and argued that such data should be used to inform farmland preservation policy throughout the United States.

The belief, however, that urban development is consuming an increasing share of the nation's best farmland due to an acceleration of population decentralization has been challenged. In a national study of 135 U.S. counties that grew rapidly between 1970 and 1980, Vesterby and Heimlich (1991) showed little change in marginal rates of urban land consumption between 1960 and the early 1980s. A study of U.S. cropland trends from 1949 to 1997 concluded that only a small fraction of the nation's cropland had been lost to suburban development (Hart, 2001). However, U.S. Department of Agriculture estimates indicate that farm acreage declined from 987 million acres in 1990 to 932 million in 2000 and to 920 million in 2008, a loss of 3.7 million acres yearly (U.S. Census Bureau, 2010).

Meanwhile, others have drawn attention to the quality and location of the replacement lands that are offsetting losses in prime farmland (Platt, 1991). When cropland located on naturally productive soils is lost to urban development, it is often replaced by cropland located on nonprime farmland, with multiple negative effects on the environment. Greene and Stager (2001) found that the approximately 11 million acres of cropland converted to urban land between 1982 and 1997 matched an equal amount of rangeland converted to cropland. In other words, the rangeland-to-cropland conversions equate to replacement lands for cropland lost to urban encroachment. Approximately one-third of the cropland lost to urban development involved prime farmland, whereas the new cropland converted from rangeland was more likely to be nonprime. It also was likely to be irrigated, as it was located principally in the arid western United States (see Figure 9.11, page 284).

The prime farmland that was converted to urban and built-up land is located in clusters in northeastern Illinois, eastern Pennsylvania, and southern Michigan and around the urban areas of Ohio and North Carolina. Other clusters of converted prime farmland are located in the central valley of California, in central Texas and south-central Florida, and near Phoenix and Tucson in Arizona. The study also showed a

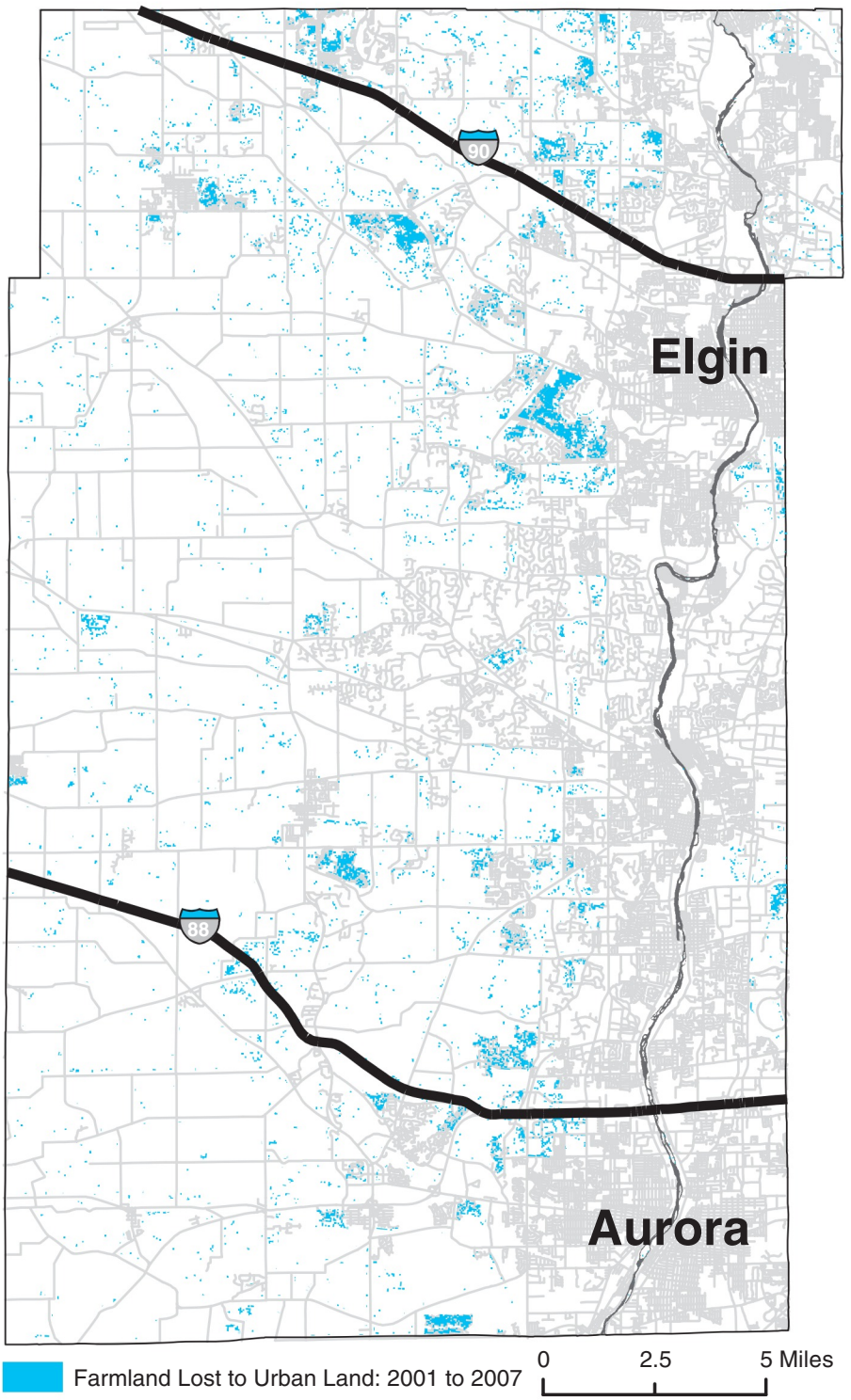


FIGURE 9.10 Prime farmland lost to sprawl on Chicago fringe between 2001 and 2007.

doubling in the percentage of irrigation for the rangeland converted to cropland during the analysis period, calling into question the sustainability of this new cropland given competing demands for water in these arid regions (Greene & Stager, 2001).

Another concern is that by focusing only on land transitions within the urban–rural fringe, we are missing millions of acres of open land in exurban areas being converted to low-density human settlement. By measuring housing density at a small geographic unit, the census block group, Theobald (2001) was able to reveal the fine-grained details of this emerging exurban settlement system (see Figure 9.12, page 285). The darker patterns on the map look familiar because the housing density cutoff for urban areas results in a spatial pattern that parallels

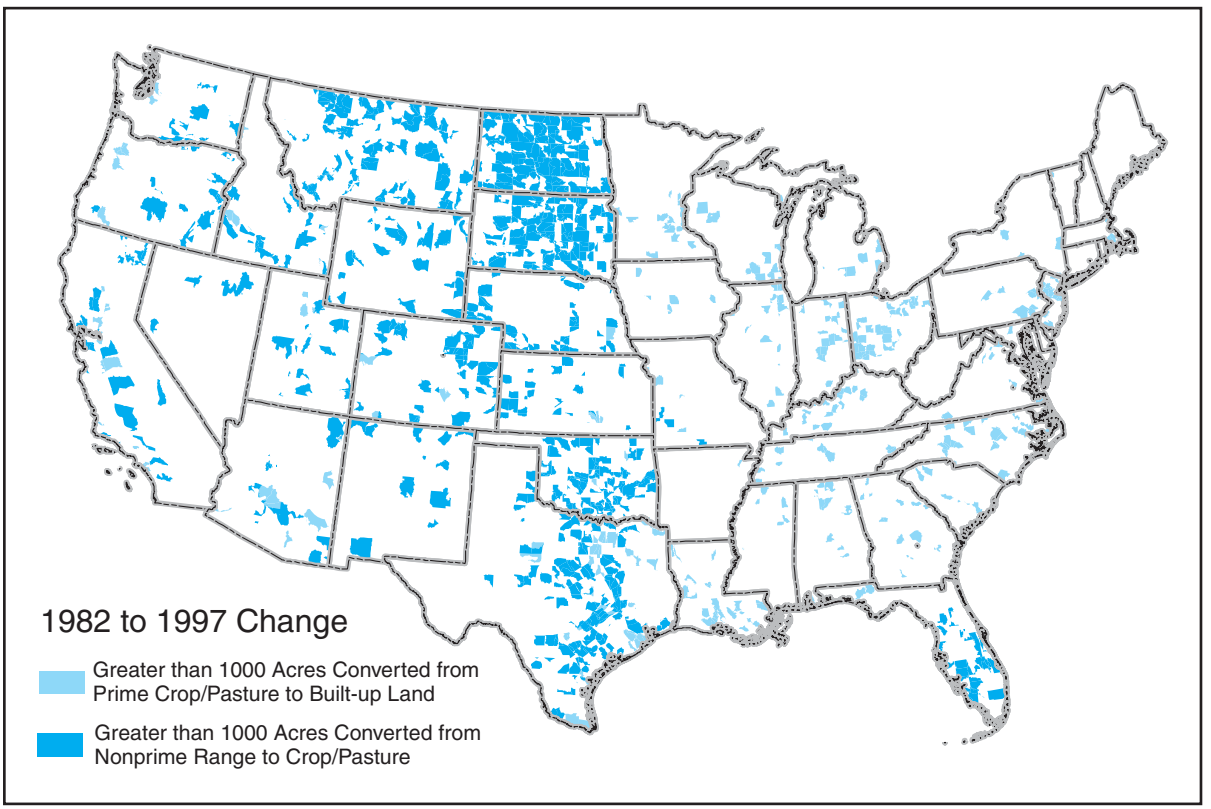

1982 to 1997 Change
Greater than 1000 Acres Converted from Prime Crop/Pasture to Built-up Land
Greater than 1000 Acres Converted from Nonprime Range to Crop/Pasture

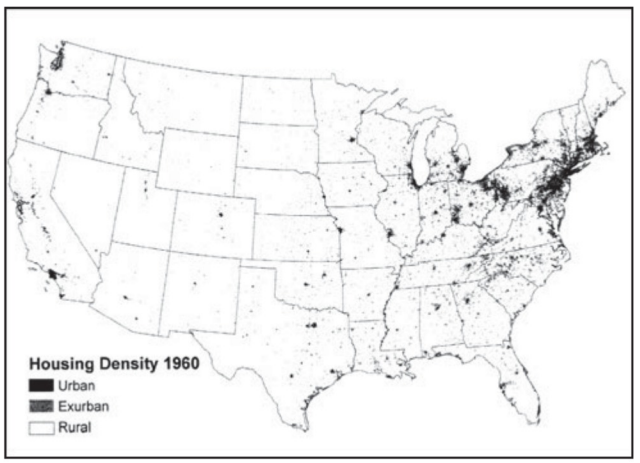
FIGURE 9.11 Cropland and rangeland conversions in the United States, 1982–1997. *Source:* Greene, R.P. and J. Stager. 2001. "Rangeland to cropland conversions as replacement land for prime farmland lost to urban development." THE SOCIAL SCIENCE JOURNAL 38:543–555. Reprinted by permission of Elsevier. Figure 2. P. 551.

the Census Bureau's own urbanized area (UA) definition. However, by utilizing housing density, the maps reveal zones of second homes, such as vacation areas, and ranchette-style developments in the West that would be somewhat less distinguishable in the mapping of population density. Light gray rings of exurban development form rings around large metropolitan areas beyond the urban fringe of those metropolitan areas.

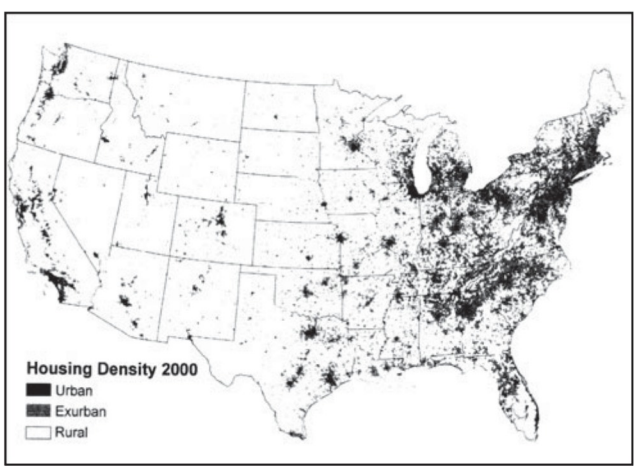
Perhaps the most noteworthy pattern in Theobald's (2001) analysis is the amount of new exurban development that occurred between 1960 and 2000. Most of the new exurban development is fill-in between urban areas, particularly in the Northeast, eastern Midwest, and South, but some of it is widely scattered west of the 100th meridian and east of the Pacific Coast, including in some remote areas. The Las Vegas cluster represents an unusual circumstance, as it was the fastest-growing area in the United States during the 1990s (see Figure 9.13). The Las Vegas map shows the census blocks of 1,000 persons per square mile for the 1990 and 2000 censuses. The largest buildup occurred on the periphery in a sector stretching northwest from the Las Vegas core. In addition, a sizable area was built up and developed to the south of the Las Vegas core, principally in the fast-growing suburb of Henderson. Much further northwest and unconnected to the other clusters, but still within the Las Vegas orbit is Pahrump, considered a "retirement hot spot" by the *Atlas of the New West* (Riebsame, 1997).

The ramifications of these fringe and exurban patterns are clear: More open land than originally thought is being encroached on. Although not all of the encroached land is being removed from farmland use, the options for its alternative uses are being reduced by its use for a low-density network of human settlement.

To summarize, studies are largely in agreement over the extent of urban sprawl, although there is much disagreement over how to measure it and interpret its significance. The bow-wave analogy for the urban–rural fringe seems realistic, as the outward push of urbanized areas always increases the value of the adjacent land in the path of urban expansion. The latter was demonstrated for Chicago, where the outward advance of the urban–rural fringe even occurred while the core of the region had regained some population. As noted earlier, the NRI data indicate that the rate of land consumption increased in the latest period of expansion. This increasing rate of land consumption has raised concerns over excessive loss of prime farmland in the wake of urbanized-area expansions. One study concluded that the amount of farmland lost to suburban development was minimal. Another study suggested that it was more significant when considering that much of the "replacement" land for high-quality farmland does not have satisfactory potential for agriculture. Finally, land development in exurban areas far removed from the conventional urban–rural fringe has not been well studied. However, these developments away from the fringe are growing.



(a)



(b)

FIGURE 9.12 Housing densities in the United States, 1960 and 2000, showing exurban development. *Source:* Theobald, D.M., 2001. "Land-Use Dynamics Beyond the American Urban Fringe." GEOGRAPHICAL REVIEW 91:544–564. © 2001 by the American Geographical Society of New York. Reprinted by permission. Figure. "Housing Density 1960 and 2000."

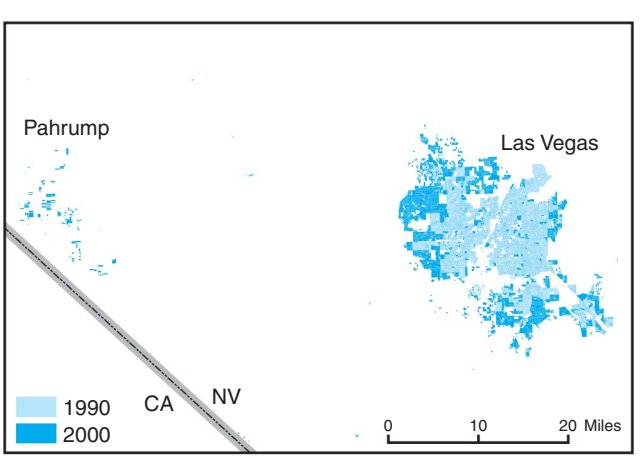


FIGURE 9.13 Exurban development in Las Vegas and Pahrump, Nevada, 1990 and 2000.

9.5 SPRAWL OUTSIDE THE UNITED STATES: THE CASE OF SYDNEY

Forsyth (1999) examined the process of planning for the development of residential housing in Sydney, Australia. Forsyth argued that Australia is between two extreme models of urban sprawl: one a largely developer-driven model, represented by the United States, and the other a more government-led and centralized model, represented by Great Britain. Forsyth examined the Rouse Hill development, a planned community that adjoins Sydney. Government plays a different role in the development of housing property in Australia than it does in the United States. In Australia, government plans for the number of houses in a new development and takes the lead role in its detailed plans.

Although the government in Australia plays a more important role in the development process than it does in the United States, the issues are similar. Forsyth (1999) identified four major interest groups. The first group is the *expansionists,* who have a strong and evocative image of an egalitarian society, inextricably linked to low-density suburbia. For *developers,* the second group, the image of the city is motivated by personal gain; they see their job as producing housing, which they can sell at a profit. A third group, the *scientific environmentalists,* favors the environment and has a regional view of the metropolis, as opposed to local environmentalists who are local in their view, similar to NIMBYs ("Not In My Back Yard") in the United States. Finally, there are the *consolidationists,* who favor compact, mixed-use development as a way to help solve the environmental, social, and financing problems of suburban developments.

9.6 TRANSPORTATION AND URBAN SPRAWL

One issue on which there is very little disagreement is the role that transportation has played in the formation of sprawl. Cities before the Industrial Revolution were predominantly very compact and dense because their geographic extents were controlled by the distances people could walk, although a few cities were larger. As a result, urban sprawl was nonexistent in its present form. In the early part of the 20th century, large North American cities grew along radial transit lines, particularly those for rail and early automobile transport, which led to concentrated growth of enterprises, housing, and other development along these routes. Especially since the development of expressways in the 1960s, development has been more spread out because of the ease of movement facilitated by the automobile. As a result, urban sprawl has become almost synonymous with automobile-oriented development. Automobile commuting in Minneapolis is shown in Figure 9.14.

It is no coincidence, then, that the opponents of sprawl often favor an alternative form of planned community known as a *transit-oriented development* (TOD). In a TOD, there is a rail station that is accessible to the residents, so they can rely on rail, rather than depending on a car. The station is surrounded by high-density development and then by successively lower density developments moving outward (Victoria Transit Policy Institute, 2003). The diameter of one TOD is usually one-quarter to one-half mile, with stations spaced one-half to 1 mile apart. Residents are

FIGURE 9.14 Automobile commuting in Minneapolis.

able to walk or cycle between the station and their homes (Victoria Transit Policy Institute, 2003).

Using housing construction statistics from 1889 to 1960, Adams (1970) developed a four-stage model to illustrate the impact of transport technology on midwestern city structure (see Figure 9.15, in which stages are designated as I–IV.). Adams first laid down the essential foundation for the model's processes, as follows. Housing densities tend to conform to roughly concentric patterns reflecting the construction period in which the units were built. On the other hand, the pattern of socioeconomic status tends to evolve in an axial or sector pattern.

In Stage 1, the *walking/horsecar era* before the 1880s, primitive horse-drawn transport systems and the distances that people could walk limited the physical expansion of cities. Lacking a transit network, the territory of movement conformed to a roughly concentric circle pattern. Immigrants arrived in large numbers during the 19th century, leading to overcrowding because the jobs were located in the central city. Thus, with the transit limitations prior to 1880, the larger American cities were both highly compact and overcrowded. Housing consisted primarily of multiple-family dwellings:

> In 1880 the core of Chicago consisted of six-story buildings. The full impact of the elevator and the electric streetcar, which were introduced on a wide scale in the 1880s, was not felt in the location and design of new residential construction until the next cycle of feverish building activity. Four- and five-story walkup apartment buildings, visible for mile after mile in places like Harlem, Brooklyn, South Chicago, and the north side and south side of St. Louis, represent the transportation and housing technology of the period in which they were built. (Adams, 1970, p. 49)

Although horsecar lines existed at the time, they were of limited importance, as most people walked until the 1880s.

The residential fabric of cities changed radically with the introduction of Stage 2, the *electric streetcar era,* which lasted from the 1880s to World War I. Streetcar rails encouraged elongated corridors of residential development, especially where land speculators purchased land in advance, sometimes with knowledge of or coercion as to where the tracks would be laid (Warner, 1962). Elongation was also encouraged by commuter stops along the interurban rail lines, such as that connecting Chicago and Milwaukee and many others in the East and Midwest. The housing type changed from multiple-family to single-family and two-family housing, and as shown in Figure 9.15, the urban form started to take on a star shape.

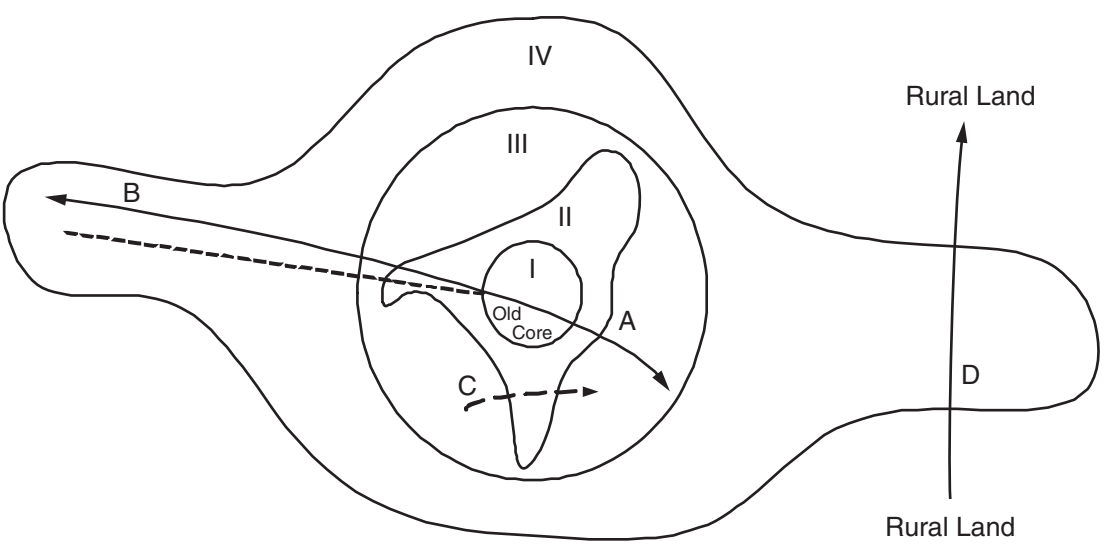


FIGURE 9.15 The Adams four-stage model of development and transport. (Traverses A through D indicate the variety of contrasting age gradients.) *Source:* Adams, John S. 1970. "Residential Structure of Midwestern Cities." ANNALS OF THE ASSOCIATION OF AMERICAN GEOGRAPHERS 60:37–62. Copyright © 1970 Routledge. Reprinted by permission of Taylor & Francis Group. Figure 15. P. 56. "Transport technology stages and their impact on urban form."

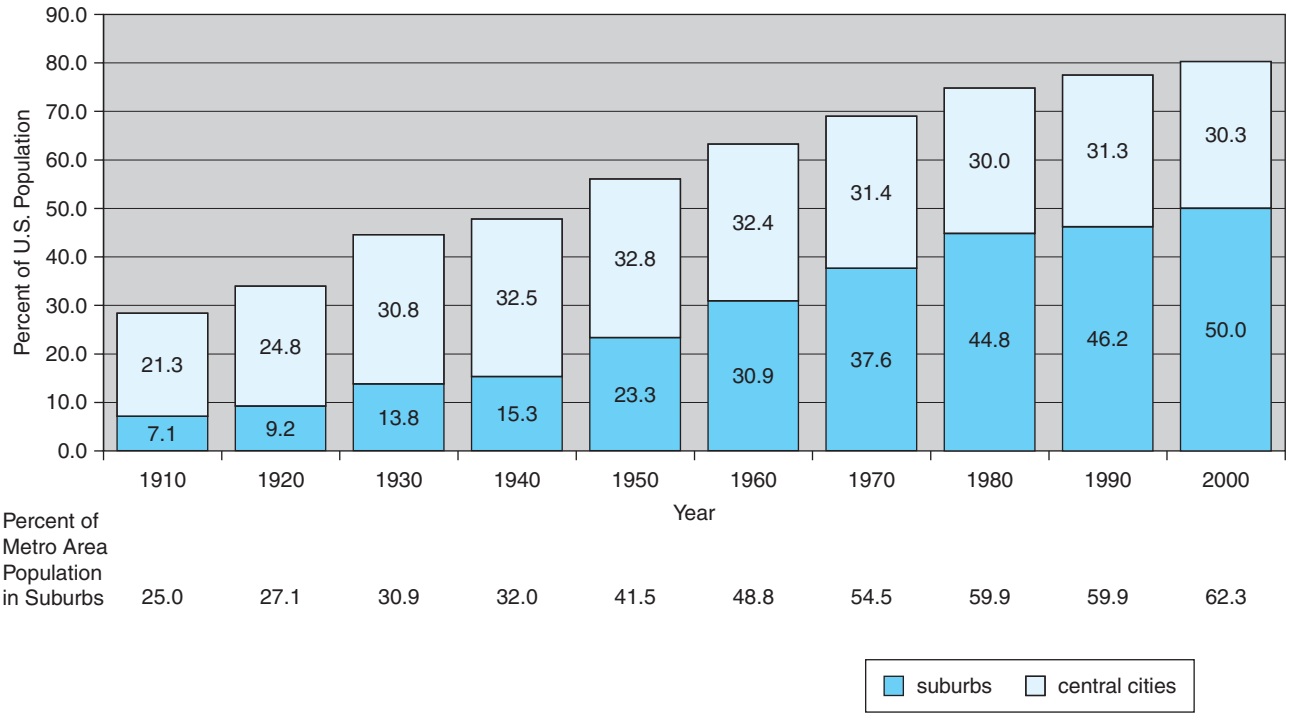


FIGURE 9.16 Percent of total population living in metropolitan areas and in their central cities and suburbs: 1910–2000.
Source: Hobbs, F. and Stoops, N. (2002). *Demographic Trends in the 20th Century: Census 2000 Special Reports, Series CENSR-4.* Washington, DC: U.S. Census Bureau. Figure 1-15, p. 33. Available at http://www.census.gov/prod/2002pubs/censr-4.pdf.

During the 1920s, or the beginning of Stage 3, the *recreational auto era,* the growing use of automobiles caused a dramatic increase in the supply of land without a proportionate increase in demand, so land in many areas became plentiful and relatively cheap. Adams (1970) referred to the 1920s as "recreational" because the widespread use of cars for commuting did not take place until the late 1930s. In some larger cities, such as Chicago and New York, the suburban railroads expanded and became an important transit feature. This led to the pre-1945 stereotypical image of suburbanite rail commuters, mostly male and affluent, who each workday left to work in the city center and returned to their families in the suburbs. At the same time, urban transport networks matured, and many cities became more star-shaped as a result.

The *freeway era,* post–World War II, saw the widespread use of the automobile for both recreation and commuting (Stage 4). The 1956 Interstate Highway Act was the most important event for the freeway era. It brought about a cataclysmic change in the spatial pattern of cities. Fast highways encouraged the very rapid expansion of the urban area. Using simple math based on the area of a circle versus its radius, Risse and Heyman (2000) calculated that the automobile increased the area of acceptable housing opportunities reachable from a given employment center by a factor of 625, due to the accessibility that the automobile network offered. The rapid expansion from the more prevalent, dispersed employment centers led to rapid growth in urban land use.

The building of thousands of miles of interstate highways, and the flexibility this expanded network offered to individuals, resulted in a more circular form of urban development, rather than a star-shaped form. People could drive directly to work, or they could live farther than walking distance from the train station or streetcar line. This contrasted with the early stages of automobile usage, when most of the expansion had been solely residential in nature. At the start of the freeway era, most manufacturers were reluctant to abandon the railroad corridors that cut across suburban rings, as the large-sized tractor-trailer truck was decades away from being an effective and efficient short-distance hauler of goods (Wheeler, 1998).

This expansion of the urban area in the freeway era occurred in three waves. The first wave's urban growth was through the construction of more residential units farther from the city core. This was fueled by the substantial pent-up demand for housing, which had built up during the economic depression of the 1930s, as well as during World War II. When the war was over in 1945, millions of returning veterans wanted housing, much of which was being built in the suburbs (Randall, 2000).

This was followed by the second and third waves of development, which had a more profound impact on the morphology of the metropolitan region. The second wave consisted of the outward movement of major retail businesses to the suburbs, and the third wave was the outward spread of employment. Vance (1991) noted that the suburbanization of retail significantly reduced the remaining support for commuting rail lines. As seen in Figure 9.16, the percentage of the U.S. population located in the suburbs grew from 7 percent in 1910 to 50 percent in 2000, and the percentage of the metropolitan area population located in suburbs, rather than central cities, increased from 25 percent in 1910 to 62.3 percent in 2000 (Schneider, 1992). Today, approximately two-thirds of U.S. metropolitan area residents are in suburbs.

9.7 EDGE CITIES

Population decentralization from the core to the periphery began early in the last century. It has a much longer history than the same process for industry and businesses. As described earlier, the process has occurred in waves, the first of which was residential dispersion. Commercial and industrial activities decentralizing in large volume in the decades after World War II represent the second wave, and the growth of offices in the suburbs in the last quarter of the 20th century represents the third wave (Hartshorn & Muller, 1989; Lang, Sanchez, & Oner, 2009). Office clusters in suburbs have been called a variety of names, including suburban employment center, suburban nucleation, suburban downtown, and edge city.

The term that seems to have become the most widely accepted is *edge city,* coined by Garreau (1991). A *Washington Post* journalist, Garreau was perhaps better at popularizing the suburban employment center concept than were his academic contemporaries. Garreau introduced his ideas through a series of news articles and published his book *Edge City* in 1991.

Lang (2003) prefers the term "edgeless city," which describes dispersed office space as opposed to clustered office space. Proponents of the edgeless city argue that office space outside traditional CBDs does not concentrate necessarily in clustered spaces, as suggested by Garreau, but rather is found in widely scattered developments (Lang et al., 2009). An edgeless city does not have a clearly defined edge, might encompass tens to hundreds of square miles of urban land, and accounts for a much larger proportion of metropolitan office space than does the edge city (Lang et al., 2009). The Miami metropolitan area exemplifies the edgeless arrangement, with 75 percent of its office space in edgeless cities as opposed to a usual range of 40–55 percent (Lang et al., 2009).

An *edge city* (Garreau, 1991) has the following characteristics:

- Has 5 million square feet or more of leasable office space;
- Has 600,000 square feet or more of leasable retail space;
- Has more jobs than bedrooms;
- Is perceived by the population as one place; and
- Is not considered part of a "city" as recently as 30 years ago.

Garreau identified edge cities for many urban areas around the country. For example, a map of high employment residence ratios (E/R ratio) in Phoenix fits the "more jobs than bedrooms" characteristic of edge cities (see Figure 9.17). These high E/R ratio areas correspond with places such as Tempe, Mesa, and Scottsdale shown in Figure 9.18 (see page 290). According to Garreau, an edge city looks and feels like a new city.

In this text, edge city is defined as a center of employment on the outskirts of the urban area, often in the suburbs, having office and retail space and perceived as one place, usually located at a highway interchange (based on Garreau, 1991). Edge cities take on many shapes and sizes, sometimes forming linear series or corridors—for example, the one outside Chicago from Schaumburg through Hoffman Estates along the Northwest Tollway outside Chicago. This remarkable corridor of edge cities includes O'Hare International Airport, Woodfield Mall, and many office parks. Its status was elevated in 1991 when Sears moved its corporate headquarters and 5,000 jobs to Hoffman Estates from the company's former headquarters in the 110-story Willis Tower (formerly Sears Tower) in downtown Chicago.

Many people are attracted to edge cities because they offer convenience, but also because there is much to do in an edge city. Besides being a place where people work, edge cities provide many shopping and entertainment opportunities. In an edge city, regional malls might be intermixed with commercial corridors and upscale hotels, often present for out-of-town visitors who are on business in the edge city or even for those who live in the region who are looking for a weekend escape. Many of these characteristics sound much like the ones ascribed to big downtowns because, in fact, edge cities are providing something of a downtown atmosphere.

An earlier investigation of the processes under way in creating the edge cities utilized the multiple nuclei model. As we saw in Chapter 3, this model had growth and development occurring around multiple centers of economic activity in a metropolitan area, rather than a single one. The classic hypothetical representation showed a metropolis with a CBD, a business center(s), and industrial suburb(s)—and all this was observed in the 1940s (Harris & Ullman, 1945). Although the type of outlying center envisioned by early researchers was different, the idea of an outlying business activity center is the same.

Urban geographers in the 1970s, 1980s, and 1990s were very active in monitoring both the evolving forms and the impacts of these outlying activity centers. Baerwald (1978) provided precise delimitation of an evolving edge city outside Minneapolis through the use of aerial photographs and other data. Muller (1981) conducted a broad and comprehensive analysis of the trends of suburban nucleation. Erickson (1986) modeled the process of multinucleation and found, among other things, that its spatial distribution was becoming more random. Cervero (1989) examined a number of traffic-congestion-related issues for the 50 largest suburban employment centers of the time. Knox (1991) linked the trend of increasing flexibility in the spatial organization of economic production to these emerging edge cities using Washington, DC, as a case study.

Subsequent to the appearance of the edge city terminology, studies have attempted to develop better empirical methods for defining and comparing edge city growth through time (Forstall & Greene, 1997; Fujii & Hartshorn, 1995; Giuliano & Small, 1991; Greene, 2008).

Giuliano and Small (1991) delimited suburban employment centers in Los Angeles using a job-density criterion:

$$\text{Job density} = \frac{\text{Number of jobs in area}}{\text{Square miles of area}}$$

Their cutoff to identify an employment center was a zone with at least 10 jobs per acre, or 6,400 jobs per square mile (Giuliano & Small, 1991).

Another useful measure to delimit edge cities is the ratio of employment to resident workers (E/R ratio), reflecting the balance of workers and jobs. The ratio is defined as follows:

$$\text{E/R ratio} = \frac{\text{Number of workers working in area}}{\text{Number of workers residing in area}}$$

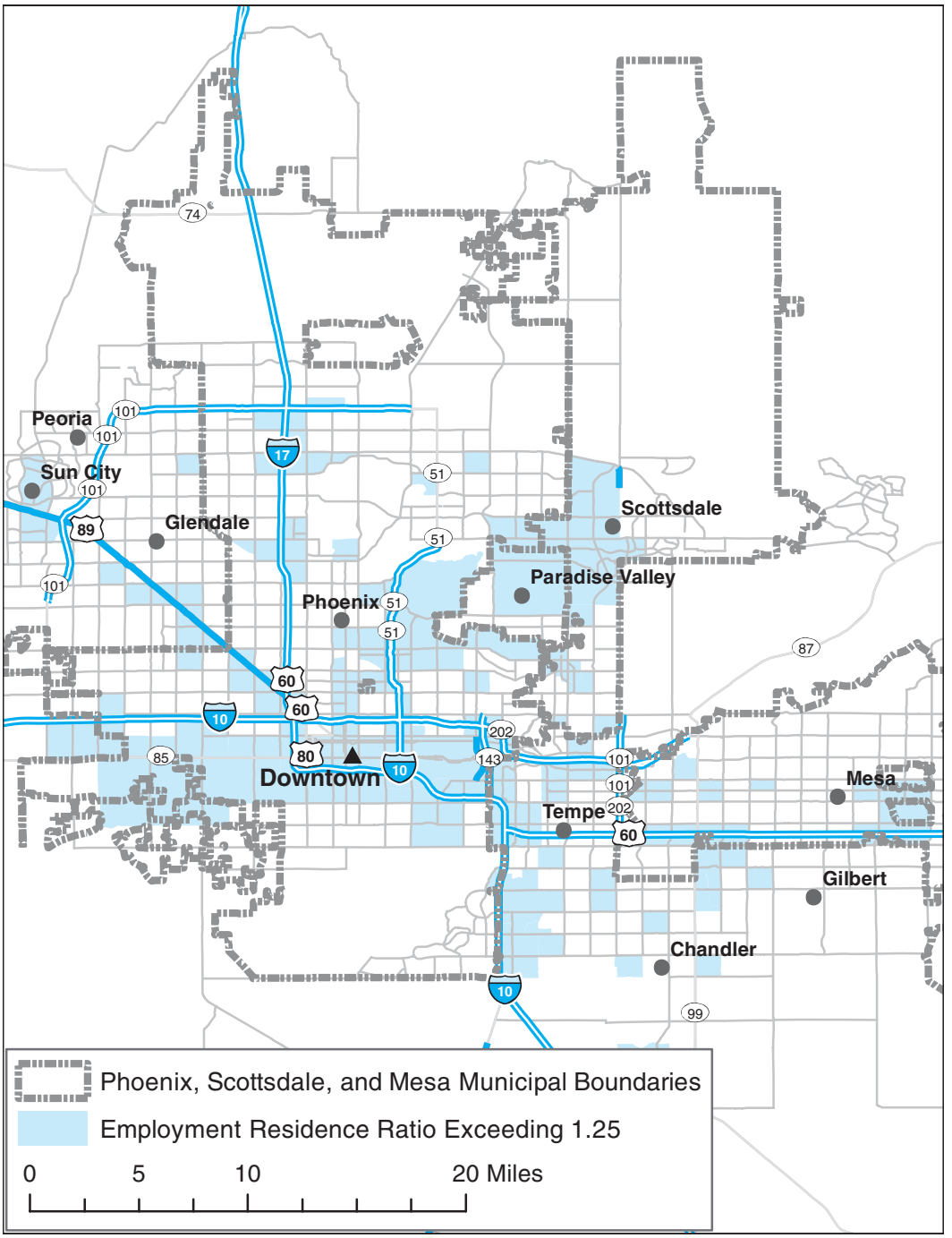


FIGURE 9.17 Edge cities and other activity centers in the Phoenix metropolitan area. *Data Source:* Census Transportation Planning Package, 200.

The ratio varies depending on the net commuting at the local level. An E/R of 1.0 or greater implies that a metropolitan zone has more jobs than it has resident workers—in other words, a net commuter inflow into the zone (Greene, 2008). An E/R below 1.0 indicates that the metropolitan zone has fewer jobs than resident workers—that is, a net outflow of workers from the area.

Edge cities can be identified in terms of places with high E/R ratios, a criterion that corresponds to the third and fourth parts of Garreau's (1991) definition. In a study of the Los Angeles combined metropolitan statistical area, employment centers were defined on the basis of census tracts with an E/R ratio above 1.25 (Forstall & Greene, 1997; Greene, 2008). A map showing E/R ratio values (see Figure 9.19, page 291) reveals some high E/R tracts (E/R over 5) located on the metropolitan periphery. These tracts are identified as constituting edge cities by the limited criterion of this measure. An advantage of the E/R ratio is that it emphasizes in-commuting to peripheral job centers. It is a

FIGURE 9.18 Scottsdale, Arizona: Fashion Square Mall. *Source:* Alan Keohane © Dorling Kindersley.

good measure to sense important job centers like airports that have a lot of land and thus are often missed with the job-density measure. However, it does not include parts 1, 2, and 5 of Garreau's definition because it does not include leasable office and retail space or lack of prior perception of the job center as "city." Those and other criteria could be added in a more intensive study.

Using a different approach, Fujii and Hartshorn (1995) isolated characteristics normally associated with a downtown area to delineate suburban employment centers in Atlanta. The importance of all these studies is to monitor the trend of the decentralization of employment from the core to the edges of metropolitan areas. However, comparisons from one city to another are difficult to make because the studies employ a variety of methods to define suburban employment centers.

Nevertheless, a study by Greene (2008) allows for a comparison of two metropolitan areas, Los Angeles and Chicago, between 1990 and 2000. In the study, the same data sources and methods were used to define 124 job centers for Los Angeles and 127 for Chicago in 2000 (Figure 9.20, page 292). Consider, for instance, the important question of how decentralized employment is in these two metropolitan areas. One part of the answer is seen at the beginning of the study period when the two downtowns were still the largest employment centers in their respective metropolitan areas, although Chicago's downtown was much bigger (see Figure 9.21, page 293). A second part of the answer is that the two areas differ in the proportion of the region's workers that work in the downtown. For Los Angeles in 2000, the proportion of the region's workers working in the traditional downtown was only 5 percent, whereas for Chicago in 2000, 14.1 percent of its workers were working in the traditional downtown. Alternatively, the extent of traditional downtown dominance is seen by comparing the gap between the downtown and the next largest employment center. For Chicago, it was almost 500,000 workers in both 1990 and 2000, but for Los Angeles, it was only 82,000 workers in 1990 and 34,000 workers in 2000, so Irvine, CA, had nearly the same employment as downtown LA. Although both metropolitan areas are polycentric (i.e., have multiple downtowns), these studies show that jobs are more dispersed among the multiple downtowns in Los Angeles than they are in Chicago.

There are many implications of the growing number of edge cities. Edge cities contribute to employment opportunities both for employers and for employees. Employers can locate enterprises at locations with less clogged transportation and often better logistical routings. In the Internet era, communications at a peripheral location can often function as well as anywhere else in the metropolis. Usually, rental prices are lower in edge cities than the downtown. Commuting to an edge city might reduce commuting time compared to traveling to the downtown, although a study in the Netherlands found commute times higher in metropolitan areas systems (Schwanen, Dieleman, & Dijst, 2003).

The environmental quality of work life is likely to be better in the edge city than in the center because pollution sources and impacts, loss of biota, and disruption to natural cycles tend to be higher in the city center. Other working and living stresses might be reduced, such as noise and crime. The weaknesses of edge cities relate to the sophistication and complexity of business and society. The range of edge cities' services is reduced compared to the CBD. The cultural and educational centers of the metropolis are less likely to be close. These pluses and minuses are in flux over time because the composition of metropolitan centers and suburbs is changing dynamically. Also, there is significant variety in edge cities, so it is hard to generalize, and practical costs and benefits might relate more to a particular edge city relative to its particular metropolitan area.

Edge cities play an important role in the future direction and growth of sprawl, as they represent competing employment hubs to the long-established downtowns of metropolitan areas. As edge cities continue to grow and expand, the urban–rural fringe has the potential for expanding much farther outward than it did in previous cycles of growth, when the downtown dominated. This is occurring as an individual figures his or her acceptable commuting range not to the downtown, but to an edge city where he or she has a job. Edgeless cities, although less studied, need to be considered as well, since they offer employment opportunities and are even more scattered than edge cities. The final sections look at smart growth and one example of the government planning

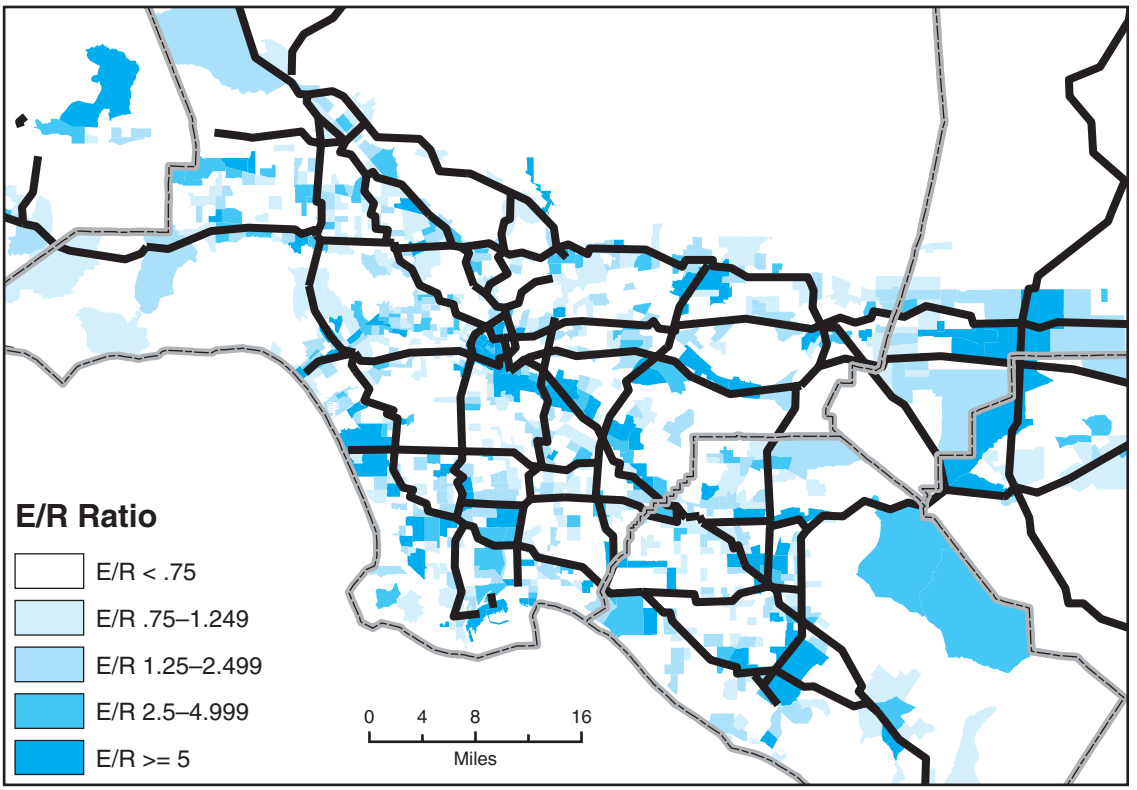


FIGURE 9.19 Employment/residence (E/R) ratios for Los Angeles relative to freeways, 1990. *Source:* Forstall, R.L. and R.P. Greene. 1997. "Defining Job Concentrations: The Los Angeles Case." URBAN GEOGRAPHY 18(8):705–739. © Bellwether Publishing Ltd. Reprinted by permission. Figure 3b. P. 717.

consequences of urban sprawl and edge cities—namely, Portland, Oregon's urban growth boundary. Other planning consequences are discussed in Chapter 11.

9.8 SMART GROWTH

The smart-growth movement, also known as new urbanism, has grown immensely, with more than 60 public interest groups forming *Smart Growth America,* a diverse coalition of groups ranging from the National Association of Home Builders to the Urban Land Institute and the Sierra Club to the American Planning Association. Talen (2005) argued that new urbanism is a culmination of ideas that have evolved over time in the American planning community in its quest for good cities. New urbanism includes many planning designs that are contrary to how most suburban communities have developed, such as building more compact developments that incorporate mixed uses. In addition, new urbanism promotes development that is friendly to commuters, including the provision of public transportation access. It often includes architectural features that are absent in many suburbs, such as front porches to encourage social interaction and gridiron streets as opposed to the more common cul-de-sac design. Smart-growth initiatives often include the protection of agricultural and environmentally sensitive lands by setting them aside as open space.

Smart-growth initiatives also address the sociological underpinnings of community that were often ignored by postwar suburbia (Whyte, 1956). The spatial layout of homes, parking, yards, and common spaces in a community is vital in promoting social contacts, helping to account for such key factors as patterns of friendships versus isolation. The smart-growth concept of sustainability implies that it is important to develop communities that can be livable for future generations without seriously damaging an area's ecosystems and natural resources.

To help communities achieve smart growth, the American Planning Association (2002) developed certain core principles, including five that relate to smart growth and to the topics covered earlier:

- A balanced, multimodal transportation system that plans for increased transportation choice;
- A regional view of community;
- Efficient use of land and infrastructure;
- Central-city vitality; and
- A greater mix of uses and housing choices in neighborhoods and communities focused around human-scale, mixed-use centers accessible by multiple transportation modes.

The transportation principle emphasizes pedestrian-friendly development and provision of transportation alternatives to the car, including public transit and bicycles. A

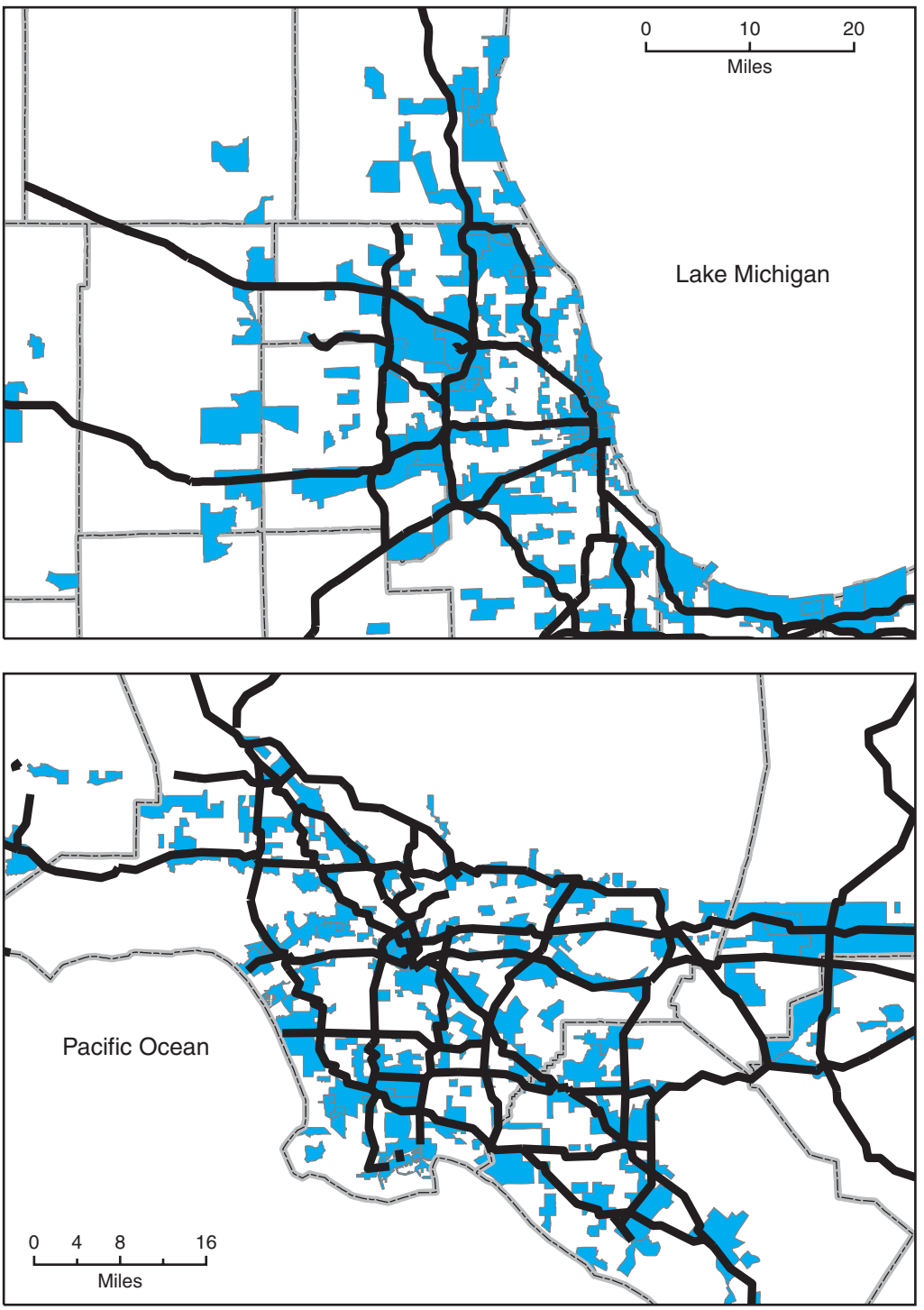


FIGURE 9.20 Chicago and Los Angeles job centers relative to interstate highways, 2000.

pedestrian-friendly example of Seattle's smart growth is seen in Figure 9.22. The regional view of the community cannot ignore municipal boundaries, but it attempts to integrate community decision making through the regional planning process. Regarding land use, smart growth encourages high-density development, infill development, redevelopment, and reuse of existing buildings. Central-city vitality is fostered by luring new development to older neighborhoods. On the fringe, smart growth encourages mixed-use development where schools, shopping, housing, community facilities, and jobs are all linked.

9.9 PORTLAND'S URBAN GROWTH BOUNDARY

Portland, Oregon, has received much attention in recent years because of its many smart-growth initiatives. Portland established an urban growth boundary (UGB) in 1985 to protect adjacent open lands from urban sprawl. All of Oregon's cities are surrounded by UGBs. The UGB is a line drawn on planning maps, delimiting the areas within which the city expects to grow (see Figure 9.23, page 294). In addition, the UGB legislation established a Portland regional agency, Metro, that oversees the UGB

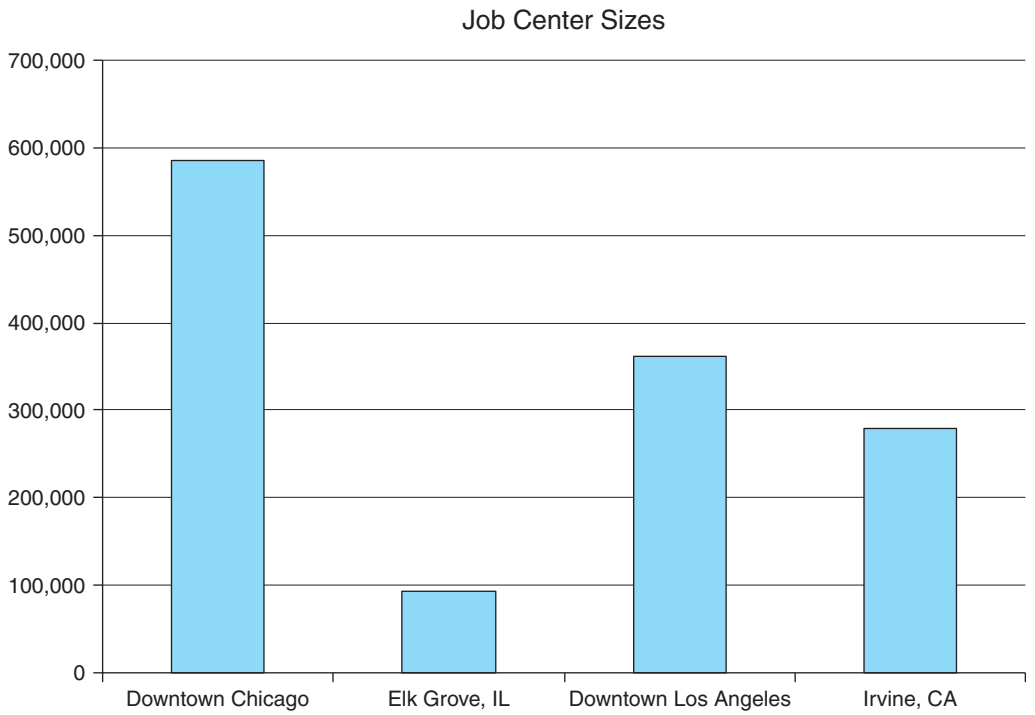


FIGURE 9.21 Relative sizes of largest job center to next largest job center, Chicago and Los Angeles metropolitan areas, 1990. *Sources:* Forstall, R. L., and Greene, R. P. (1997). "Defining job concentrations: The Los Angeles case." *Urban Geography* 18:705–739; Greene, R. P., and Forstall, R. L. (2001). "Urban expansion of Chicago: The late post-suburban period." In *Hamburg and Its Sister Cities,* edited by J. Lafrenz. Hamburg, Germany: University of Hamburg.

FIGURE 9.22 Pedestrian-friendly smart growth in Seattle.

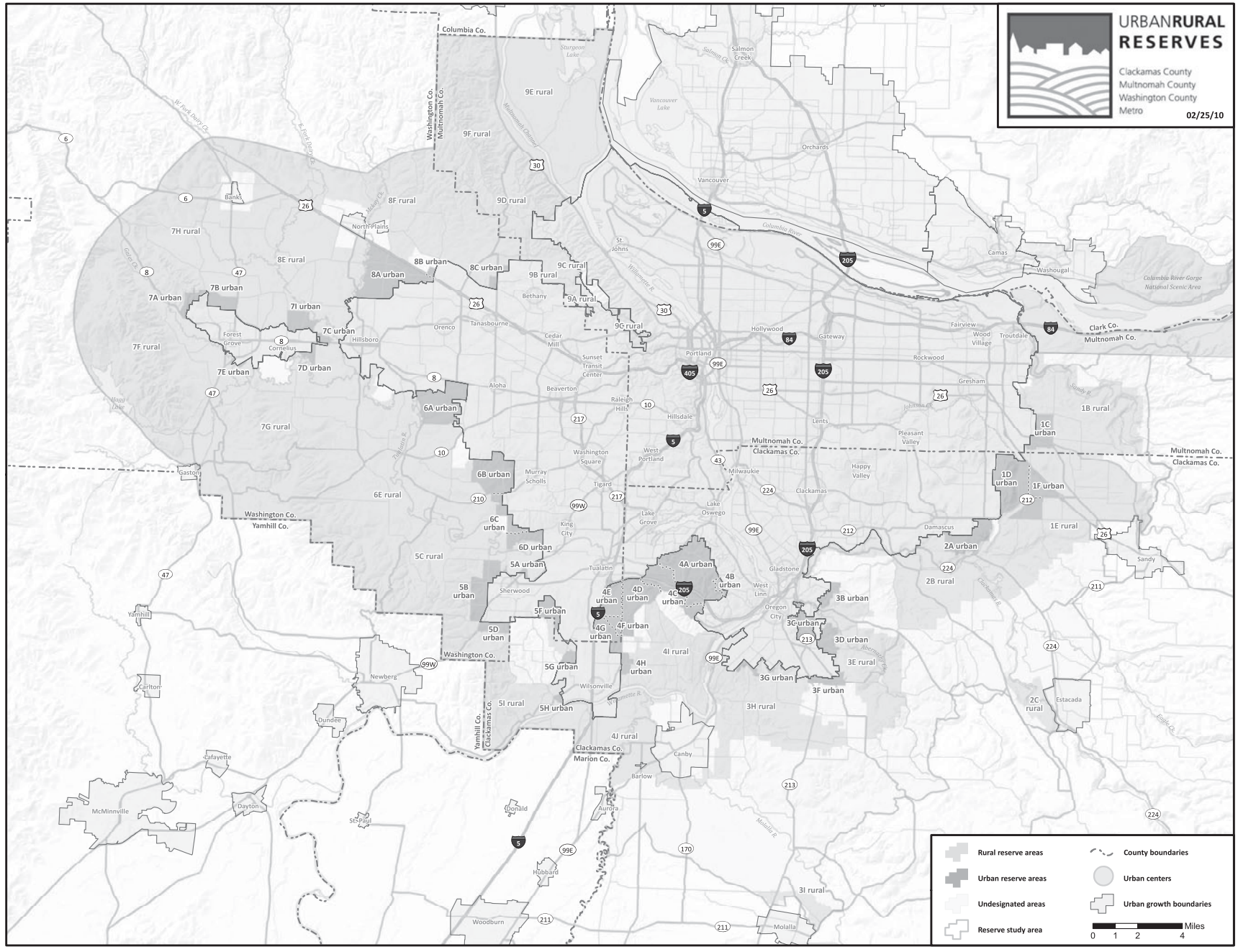


FIGURE 9.23 Portland's urban growth boundary and proposed urban and rural reserves, 2010. *Source:* Urban Rural Reserves, Clackamas County, Multnomah County, Washington County and Metro. http://library.oregonmetro.gov. Courtesy Metro Regional Center, Portland, OR.

(Metro, 2010). State law requires that the UGB include enough land for 20 years of anticipated residential development, so the line is subject to review and has been moved outward over time—a feature that has resulted in some criticism from interests opposed to growth who would like to freeze the line's position.

Nevertheless, Portland's UGB has achieved much success in containing sprawl and making Portland a more efficient user of land (Porter, 1997). Metro's responsibilities include regional urban long-range planning; development of future vision for the metro area; transportation planning; operation of a solid waste disposal system, the Oregon Zoo, the Oregon Convention Center, and other trade and visitor buildings; management of parks and open spaces; fish and wildlife protection; natural disaster planning and response; and maintenance of regional GIS systems and databases (Metro, 2010). Many of these include economic incentives to encourage growth within the UGBs (Metro, 2010).

The tough growth control measures of Oregon, including UGBs, had a setback from a November 2004 ballot initiative that allowed property owners who could prove that UGBs had hurt their investment to seek compensation or an exemption from the rules. Although a lower court found the measure to be unconstitutional in 2005, the Oregon Supreme Court reinstated it in 2006. In 2007, the Oregon voters passed legislation that was more specific and allowed for home building as compensation. At the same time, the legislation called for Metro and the three metropolitan Portland county governments to identify, for the next 50 years, urban reserves—that is, areas outside the present UGB to be reserved for residential and employment uses—and rural reserves—that is, areas outside the present UGB to be reserved for farming and natural uses (Metro, 2010). In early 2010, after extensive negotiation, an agreement was reached on the 50-year reserves, which consist of 272,000 acres for rural use and 28,086 acres for urban use (Sustainable Business Oregon, 2010). As seen in Figure 9.23, the urban reserves are mostly in Washington County to the west and Clackamas County to the south. For Multnomah County, which includes Portland's central city, urban growth would come from the reuse and filling-in of land inside the UGB. The very long-term approach to planning the urban fringe protects against haphazard, leapfrog fringe development, reduces sprawl, and protects many environmental features, but restricts some entrepreneurial business initiatives and growth. Portland has again affirmed that it is an unusual metropolitan area in terms of the role its governments play in allowing urban fringe expansion in a slow, careful, and measured way.

Summary

This chapter covered the key topics in urban geography of suburban growth, urban sprawl, edge cities, and smart growth. By 1970, the number of Americans living in suburbs outnumbered those living in central cities. In the late 20th and early 21st centuries, central cities steadily declined as a percentage of metropolitan areas, whereas suburbs grew to have a two-thirds share of the overall metropolitan population. One consequence of this redistribution for some central cities is underutilization or abandonment of urban infrastructure built for high population densities. For suburbs, the growth has been largely characterized by urban sprawl, with mainly low-density, single-use development that has strained urban transportation systems. Employment has also been redistributing from the CBD to edge cities, whose locations often are convenient to highway interchanges, thus providing excellent vehicular transport access. Edge cities have expanded the reasonable commuting reaches of metropolitan areas because they lie between the urban fringe and the downtown. Smart-growth policies that are designed to strengthen the central city and make development more land efficient in the suburbs are being more widely applied throughout the United States. Portland, Oregon, has served as a model metropolitan area for such smart-growth initiatives.

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Exercise

Exercise Description

Measuring the ever-changing and outward expansion of the Chicago urban fringe in the period from 1960 to 2000.

Background Information

The Peri-metropolitan Bow Wave: In this project, we accept the idea of the urban fringe as a peri-metropolitan bow wave: "The bow wave is a standing wave that always remains immediately in front of the bow of a ship moving through water. The urban–rural fringe, then, is the bow wave of the built-up area of the city, the zone of intensively cultivated, high-priced agricultural land that remains immediately in front of the expanding urban edge" (Hart, 1991, p. 36).

You are asked to create 10-mile rings outward from the center of downtown Chicago and to measure each ring's proportion of population living in growing census tracts for two time periods, 1960 to 1980 and 1980 to 2000. You are then asked to determine whether or not the results confirm that the Chicago urban–rural fringe is analogous to a bow wave.

Course Concepts Presented

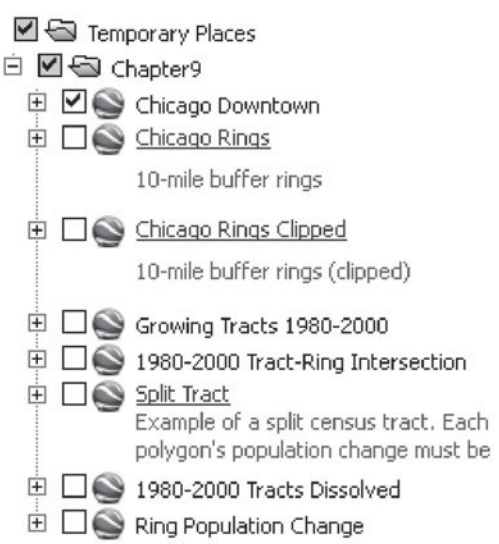
Urban fringe and urban sprawl.

Google Earth Version

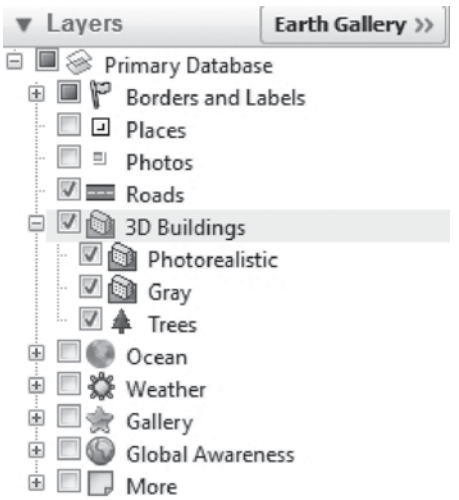
1. Launch the Chapter 9 Google Earth KMZ file by double-clicking it:

   EUC_Ex9.kmz

2. Expand Temporary Places under Places within Google Earth.

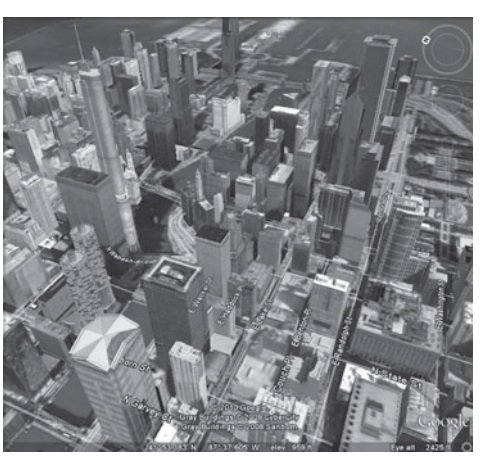


3. Place a check mark next to Chicago Downtown. Double-click Chicago Downtown to zoom in on it.
4. To provide more context, place check marks next to Roads and 3D Buildings under Layers.

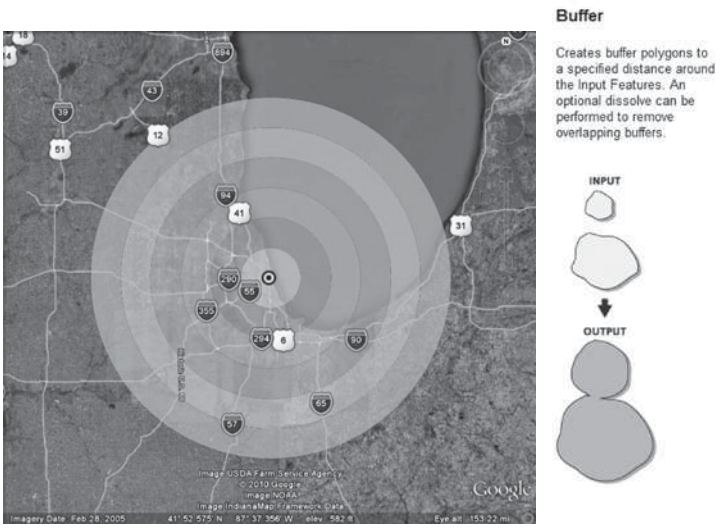


5. You are zoomed in on the intersection of State and Madison Streets, which is considered the heart of Downtown Chicago.

6. Pan north until you get to the Chicago River, and then use the Google Earth Navigation Compass to view the downtown looking toward Lake Michigan. As you move south, many prominent urban features are visible in this view, including Fort Dearborn, the initial settlement point for Chicago; Millennium Park, the northern part of Grant Park, designed by Daniel Burnham, the author of the great Chicago Plan; the Art Institute of Chicago, one of the greatest U.S. art museums; and the Magnificent Mile, the famous North Michigan Avenue retail corridor.

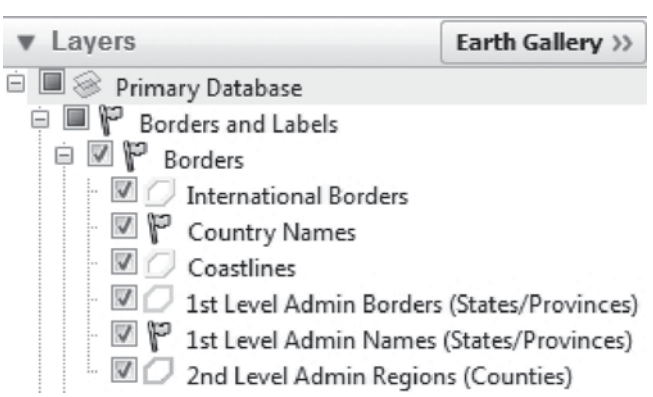


7. Turn off 3D Buildings and double-click Chicago Downtown again to go back to the intersection of State and Madison.
8. Now double-click Chicago Rings to zoom out to the study area. Place a check mark next to Chicago Rings to examine the result of a GIS buffer routine that produced six 10-mile rings going out from Downtown Chicago.

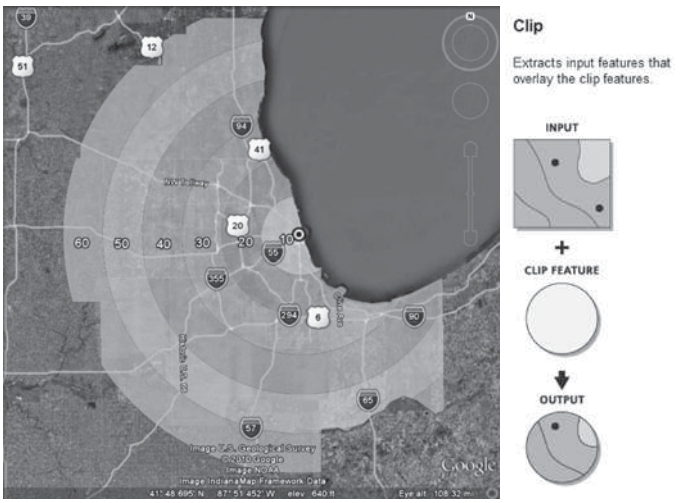

Buffer
Creates buffer polygons to a specified distance around the Input Features. An optional dissolve can be performed to remove overlapping buffers.
INPUT
OUTPUT

We created these six 10-mile rings in our GIS so we can examine the peri-metropolitan bow-wave process discussed in the "Analyzing an Urban Issue" section of the chapter. We will examine population change in each of the rings for two time periods to see if the growth trends mimic a bow wave.

9. Uncheck Chicago Rings, and now double-click Chicago Rings Clipped to zoom to our refined study area. Place a check mark next to Chicago Rings Clipped to examine the results from our GIS clip procedure. Also, turn on County Boundaries under Layers, Borders and Labels, Borders, and 2nd Level Admin Regions (Counties).

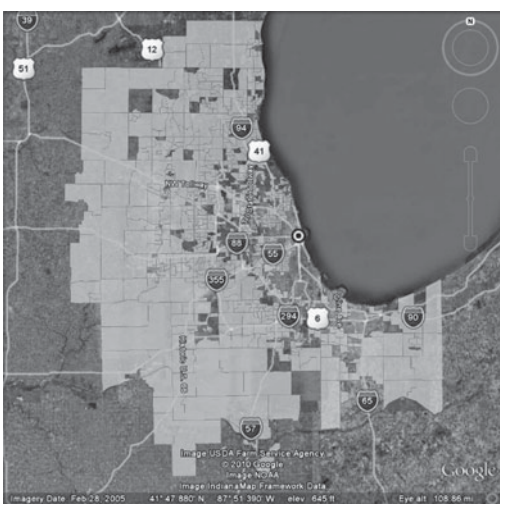


10. With the GIS clip procedure, we excluded part of the rings created from the original GIS buffer routine because they extended into Lake Michigan and we do not have population data covering the lake.



The GIS clip procedure used the 13 counties composing the 2000 Chicago metropolitan area as the clip layer and the rings as the input layer. The GIS clip procedure is sometimes called a cookie cutter, where the rings are the dough and the counties are the cookie cutter. Thus, these clipped 10-mile rings make up our Chicago bow-wave study area.

11. Now uncheck Chicago Rings Clip, and double-click Growing Tracts 1980-2000 to zoom to a GIS layer of census tracts that grew in population between 1980 and 2000. Place a check mark next to this layer to examine it.



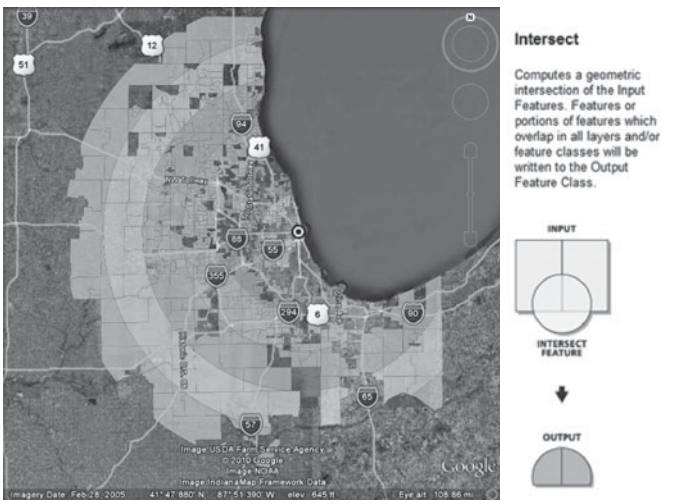
Table

ch_80_00

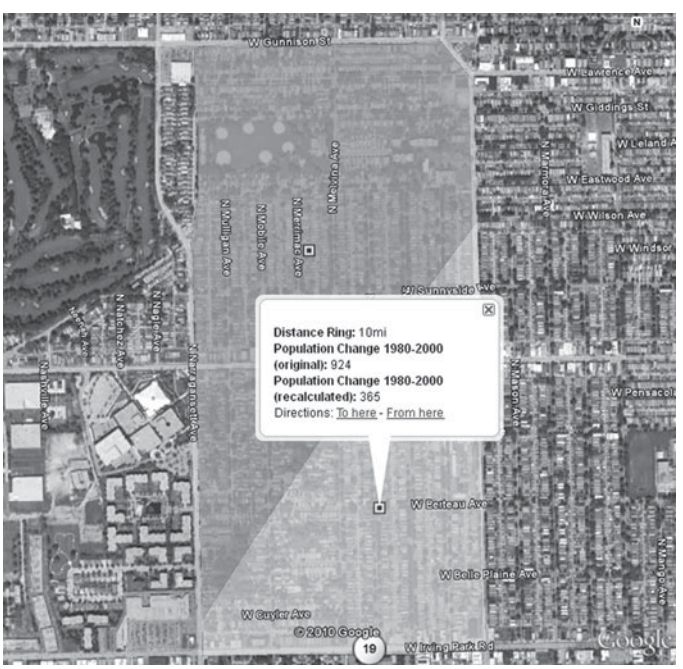
FID	Shape *	chg80_00	orig_area
0	Polygon	1606	133899193.62039
1	Polygon	55	30210170.92658
2	Polygon	4915	843869663.13773

The attribute table of Growing Tracts 1980-2000 has a field called chg80_00, which contains a value indicating the amount of increase over the 20-year time period. A similar attribute table and field exist for the 1960-to-1980 time period, but they are called Growing Tracts 1960-1980 and chg60_80, respectively.

12. Uncheck Growing Tracts 1980-2000, and now double-click 1980-2000 Tract-Ring Intersection. Place a check mark next to 1980-2000 Tract-Ring Intersection to examine the results from our GIS intersect procedure.

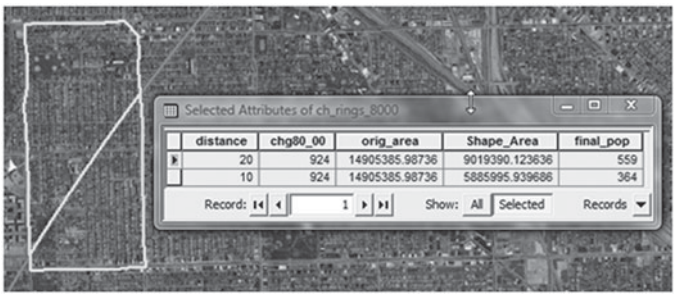

Intersect
Computes a geometric intersection of the Input Features. Features or portions of features which overlap in all layers and/or feature classes will be written to the Output Feature Class.
INPUT
INTERSECT FEATURE
OUTPUT

13. The GIS intersection procedure intersected the clipped rings and the growing census tracts, resulting in a new layer with polygons representing areas that were common to both input layers. This procedure is ideal for our analysis, as we can now count population growth by ring, but a problem with this procedure is seen where a ring intersects a growing census tract, resulting in two polygons with the same population increase. Uncheck 1980-2000 Tract-Ring Intersection, and check Split Tract; then double-click Split Tract to see an example.

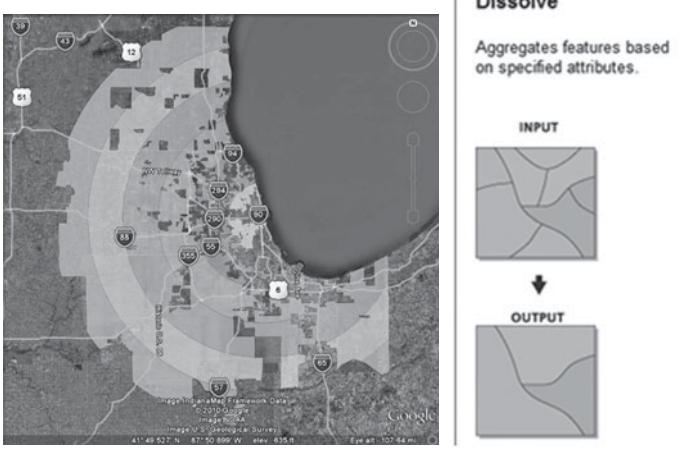

Distance Ring: 10mi
Population Change 1980-2000 (original): 924
Population Change 1980-2000 (recalculated): 365
Directions: To here - From here

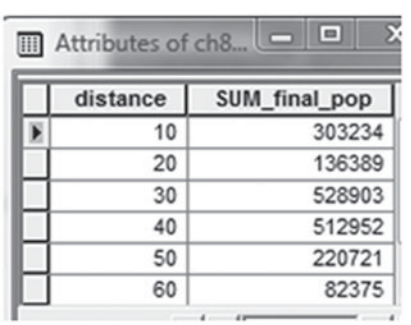
14. The problem is corrected in the GIS by allocating the population increase proportionally to each part of the split tract, using the following equation:

$$\text{Final\_pop} = [\text{chg60\_80}] * ([\text{new\_area}] / [\text{orig\_area}])$$


Selected Attributes of ch_rings_8000
distance | chg80_00 | orig_area | Shape_Area | final_pop
20 | 924 | 14905385.98736 | 9019390.123636 | 559
10 | 924 | 14905385.98736 | 5885995.939686 | 364
Record: 1 Show: All Selected Records

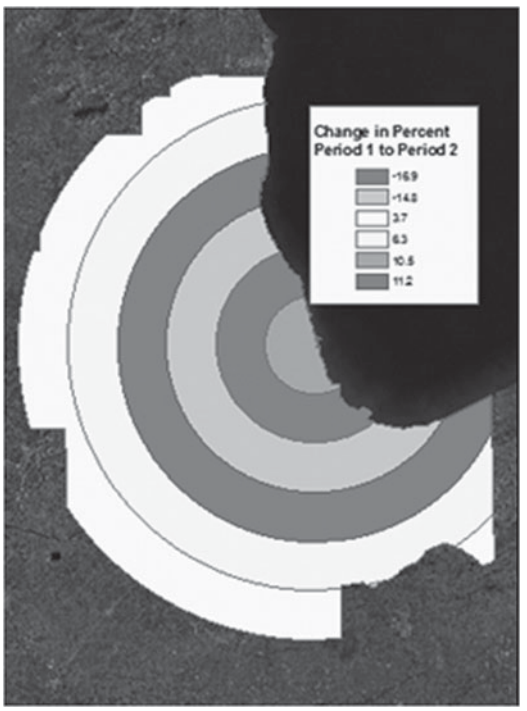
15. Uncheck Split Tract, and now double-click 1980-2000 Tracts Dissolved. Place a check mark next to 1980-2000 Tracts Dissolved to examine the results from our GIS dissolve procedure.





The GIS dissolve procedure aggregated the tracts based on the distance field. In addition, it summed the total population increase by the distances. The latter dissolve procedure was repeated for the earlier 1960-to-1980 time period.

16. A final GIS layer called Ring Population Change was created, and a field was added to compute the difference between the percentages in each ring over the two time periods.



	1960 to 1980		1980 to 2000		Difference
	Total	Percent	Total	Percent	Change in Percent
Ring 1	132,448	6.45%	303,417	16.99%	+10.54
Ring 2	505,229	24.58%	136,482	7.64%	−16.94
Ring 3	915,004	44.52%	529,055	29.63%	−14.89
Ring 4	360,550	17.54%	513,073	28.74%	+11.20
Ring 5	124,404	6.05%	220,785	12.36%	+6.31
Ring 6	17,271	0.84%	82,406	4.61%	+3.77

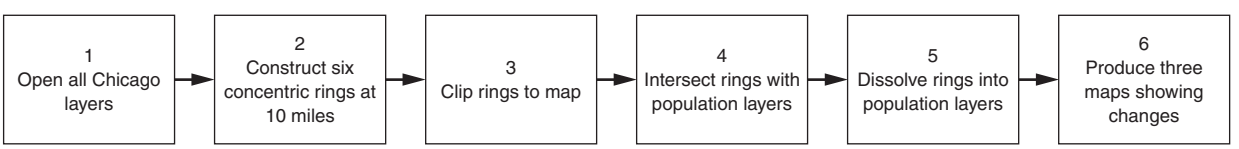
Note: Percent derived by dividing total growth in ring by total growth in region: 2,054,906 total regional growth between 1960 and 1980. 1,785,218 total regional growth between 1980 and 2000.

17. Save the map that is displayed as a jpg, and submit it with your essay.

Google Earth Short Essay: Discuss the strengths and weaknesses of the GIS methods demonstrated in Google Earth to monitor outward expansion of the urban fringe and sprawl for the Chicago region. Zoom into the innermost ring, and find evidence of residential condo development or other features that would explain the regrowth of that ring. Then find an example of declining landscapes or structures in the second or third ring that would be symbolic of the population decline that has occurred there in the last 40 years. Finally, explore the outermost ring for new suburban subdivisions or other growth elements that might be used to illustrate the recent population growth that the ring has experienced. Compare and contrast these landscapes in your essay.

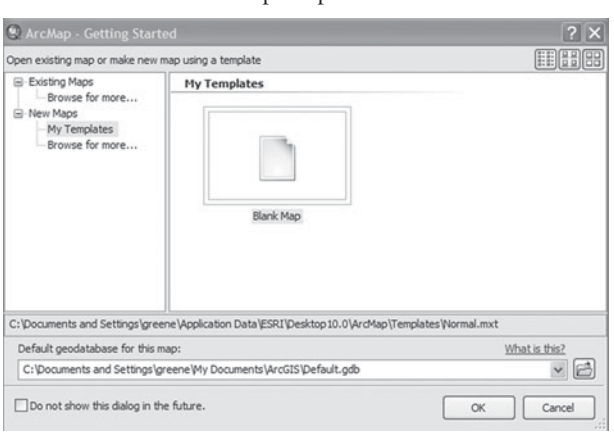
ArcGIS 10 Version

Exercise Procedure Flow Chart



Part 1: Location of Peri-metropolitan Bow Wave and Concentric Ring Analysis of Sprawl: 1960 to 1980

1. Start ArcMap. Under New Maps, click My Templates, and then double-click the Blank Map template.

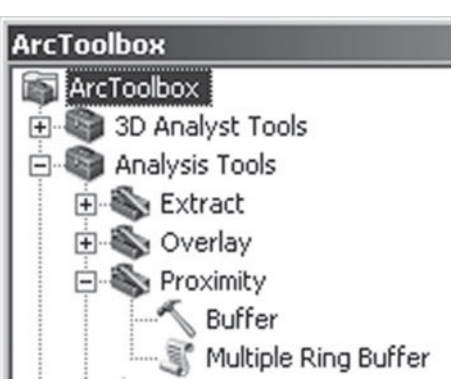


2. Click Add Data, and navigate to the exercise data folder.

Note: If you do not see the folder where you placed the exercise data, you will need to make a new connection to the root directory that holds the data.

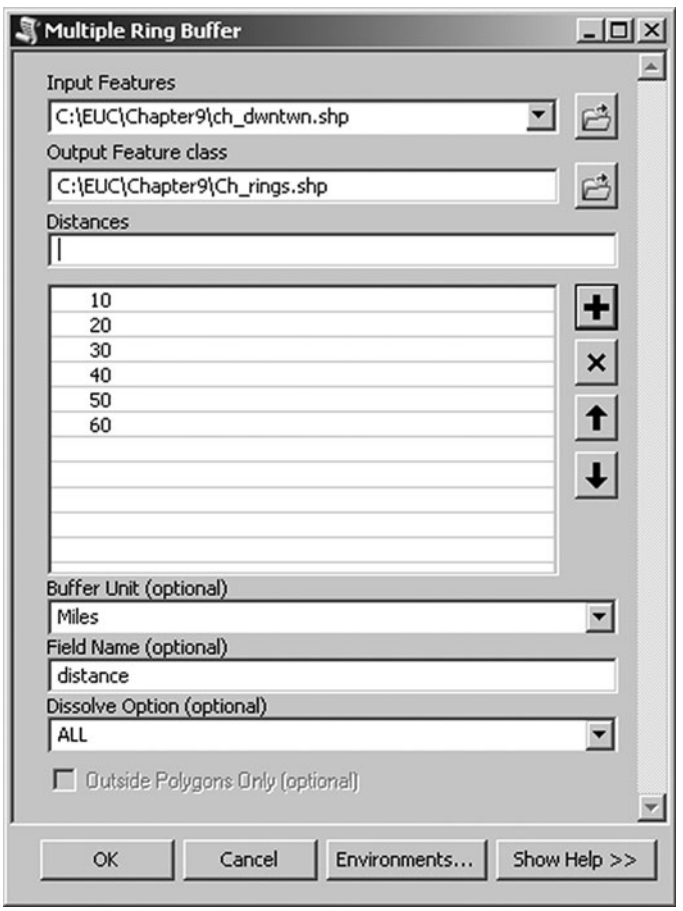
3. Add ch_dwntwn, cnty13, ch_60_80, and ch_80_00 from the Chapter 9 folder. You can add all four at once by clicking one of the file names, clicking the others while holding down the Ctrl key on the keyboard, and clicking Add.

4. Click ArcToolbox, select Analysis Tools and Proximity, and double-click Multiple Ring Buffer.

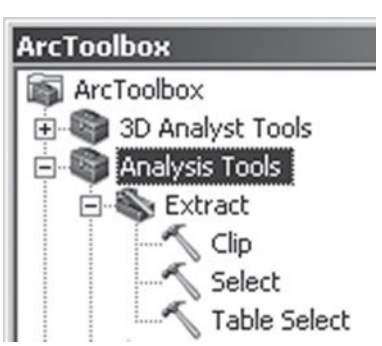


5. Create six 10-mile rings around Downtown Chicago. In the Multiple Ring Buffer window, set ch_dwntwn.shp (full path, which might be different on your machine) as the Input Features and Ch_rings.shp (full path) as the Output Feature class. Note that Ch_rings.shp does not exist yet, and this step

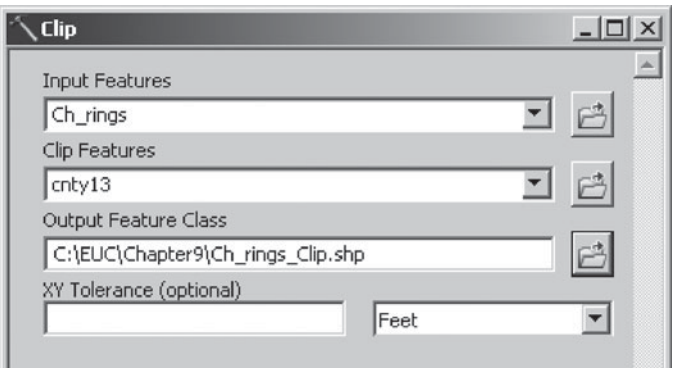
creates it. Enter 10 into the Distances box, and click the plus sign to the lower right. Repeat by entering 20 through 60. Select Miles as the Buffer Unit. Please note that you may need to scroll down with the right-hand slide bar to enter this. Click OK. A progress bar will appear at the bottom right of the ArcMap window.



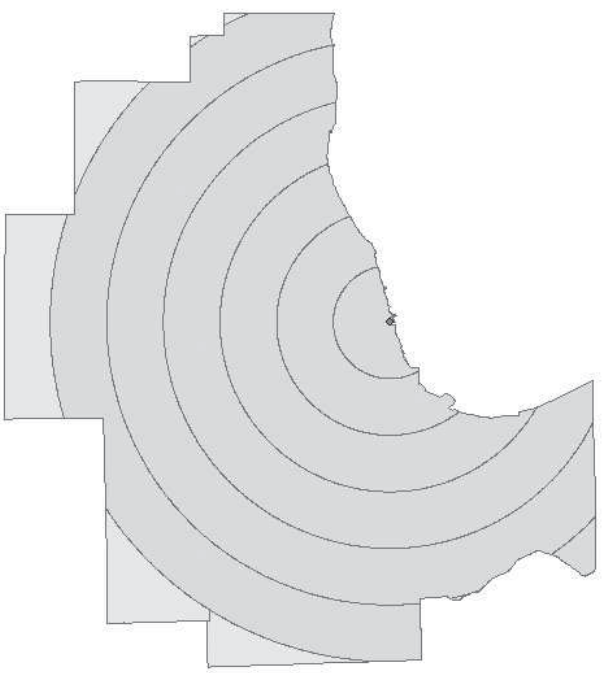
6. When finished, you will have a new layer of rings called Ch_rings.
7. The rings extend beyond the study area, so we clip them by the county file. Click ArcToolbox, and select Analysis Tools, Extract, and Clip.



8. In the Clip window, select Ch_rings.shp from the dropdown menu as the Input Features, select cnty13.shp as the Clip Features, and create Ch_rings_Clip.shp for the Output Feature Class. Click OK.

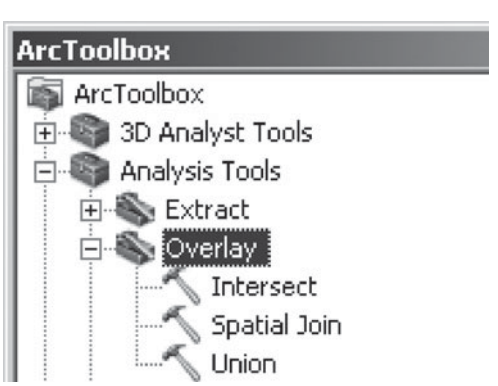


9. When finished, turn off Ch_rings, and you will see the new layer of rings clipped to the study area boundary.

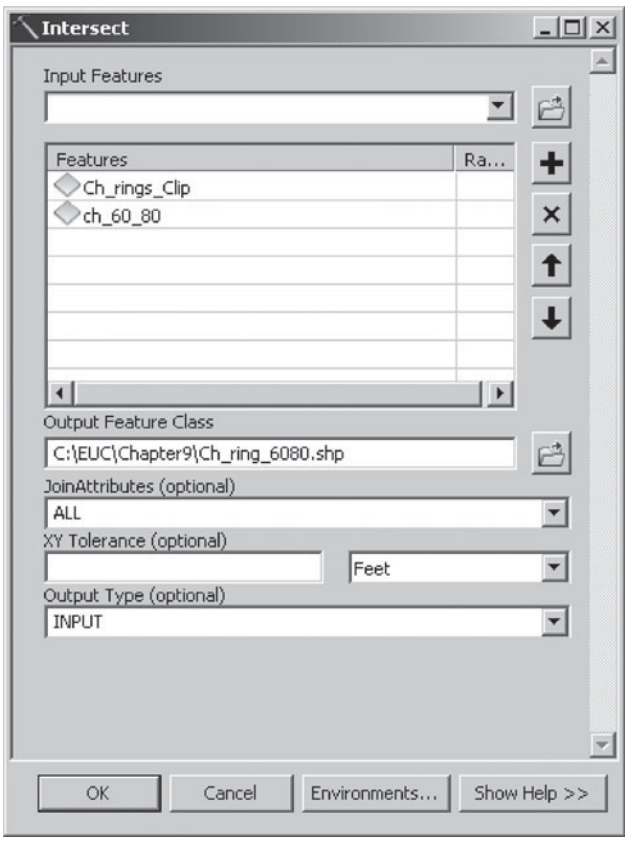


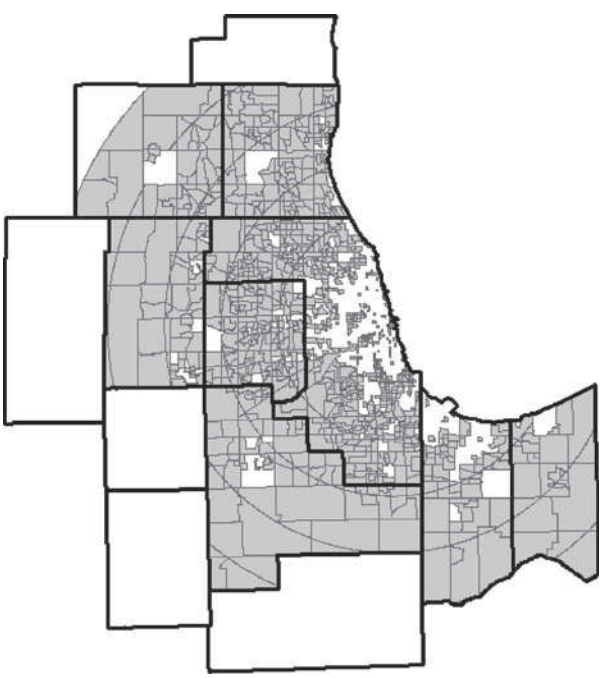
You will now perform a GIS intersection of ch_60_80 and Ch_rings_Clip.

10. Click ArcToolbox, and then select Analysis Tools, Overlay, and Intersect.



11. For the Input Features, select Ch_rings_Clip.shp from the drop-down list. Repeat for ch_60_80.shp as the second Input Features. For the Output Feature Class, browse to your data folder, and enter Ch_ring_6080.shp. Click OK.



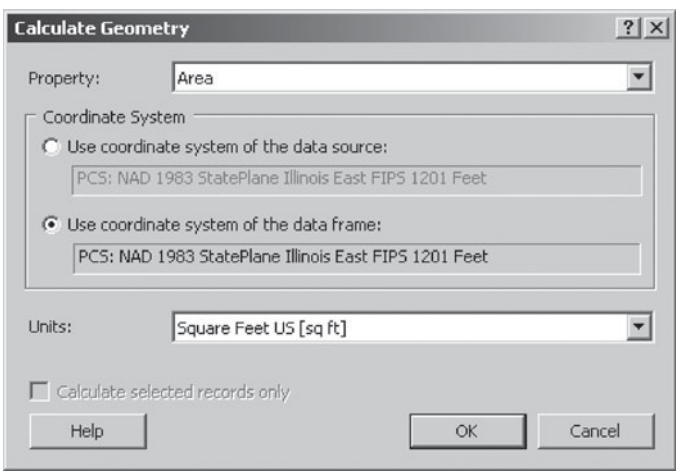


After the GIS intersection of the census tracts layer with Ch_rings_Clip, the output layer includes census tracts that have been split into multiple tracts. In addition, the new attribute table containing population includes multiple records and population is grossly overcounted. We correct for this overcounting by multiplying population in the final layer by the new_area divided by the orig_area. This treats the tracts as though population is evenly distributed throughout the original tract, an assumption that might not necessarily be true, but is necessary to make. To implement this correction, you first add new_area to our resulting intersected layer table, and then compute the corrected population.

12. Right-click Ch_ring_6080, and select Open Attribute Table. Click Table Options, and click Add Field; call it new_area as type float with a precision of 16 and a scale of 5.

13. Right-click on new_area, and select Calculate Geometry (answer Yes if you are asked to continue).

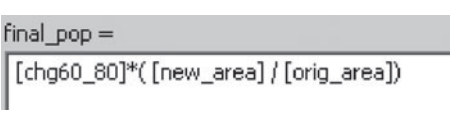
14. Use the coordinate system of the data frame, and use US square feet, which are the default units. Click OK.



15. Add a field called final_pop as type float with a precision of 16 and a scale of 0.

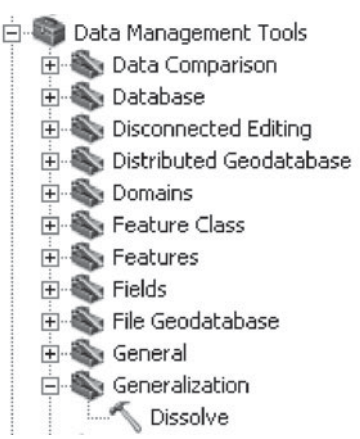
16. Right-click final_pop, select Field Calculator, and calculate as follows:

[chg60_80]*([new_area]/[orig_area])

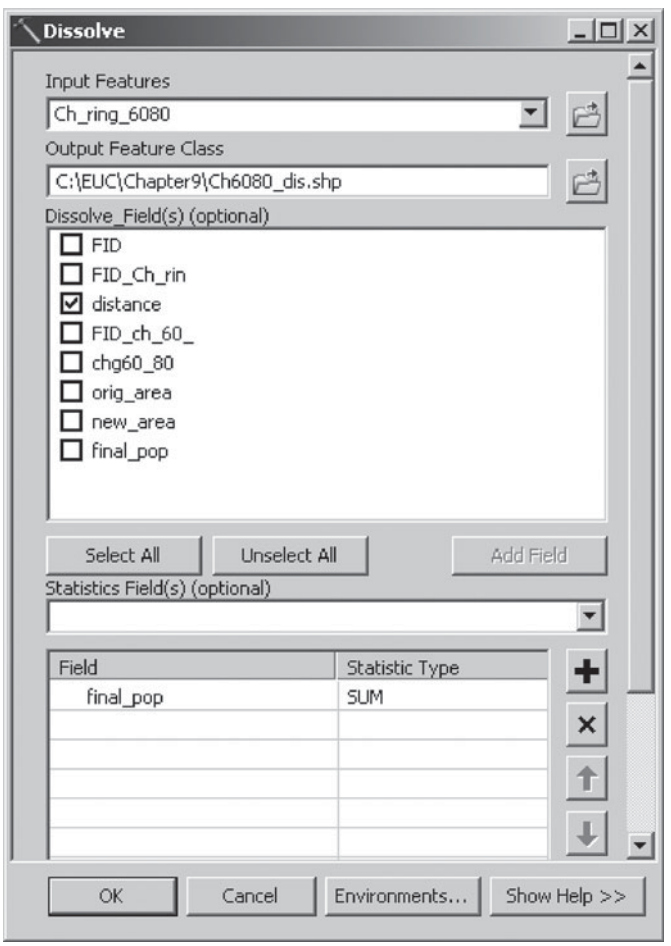


17. Click OK.

18. Click ArcToolbox, and then select Data Management Tools, Generalization, and Dissolve.



19. Select Ch_ring_6080.shp from the dropdown menu as the Input Features layer and Ch6080_dis.shp as the Output Feature Class to create. Select Distance as the dissolve field. You will then scroll to the bottom of the Dissolve dialog box and add final_pop as a field to compute a sum of during the dissolve process. To do this, choose final_pop from the Statistics Field dropdown list. Click on the blank area below the Statistic Type header, and choose SUM from the dropdown list. Click OK.



20. When finished, turn off all layers except Ch6080_dis, identify each ring (identify icon), and verify that the population increase in growing census tracts by ring is correct. Or open the attribute table of Ch6080_dis to verify the pop numbers. Your results should approximate those shown below in the Total column under "1960 to 1980":

	1960 to 1980		1980 to 2000		Difference
	Total	Percent	Total	Percent	Change in Percent
Ring 1	132,448	6.45	303,417	16.99	+10.54
Ring 2	505,229	24.58	136,482	7.64	−16.94
Ring 3	915,004	44.52	529,055	29.63	−14.89
Ring 4	360,550	17.54	513,073	28.74	+11.20
Ring 5	124,404	6.05	220,785	12.36	+6.31
Ring 6	17,271	0.84	82,406	4.61	+3.77

Note: Percent derived by dividing total growth in the ring by total growth in the region, with total regional growth of 2,054,906 between 1960 and 1980 and 1,785,218 between 1980 and 2000.

Part 2: Location of Peri-metropolitan Bow Wave and Concentric Ring Analysis of Sprawl: 1980 to 2000

Repeat Steps 10 through 20 for the 1980-to-2000 period (use ch_80_00 as an input layer in the intersection step, and be careful to give unique file names to the output layers that you create). Change the numerator in the equation in Step 16 to [chg80_00]. For Step 19, use appropriate file names to refer to 1980 to 2000. When finished, verify that the data in the Total column under "1980 to 2000" and the Difference column are correct.

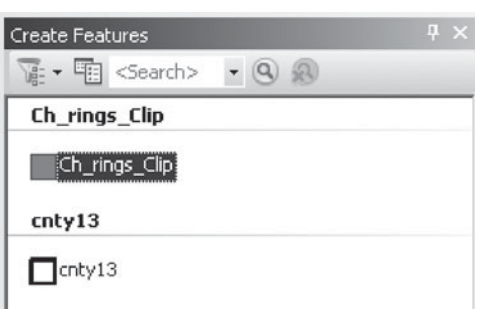
Part 3: Mapping the Change (Advanced users can find an alternative approach for steps 21-31 on page 306 in a ***Challenge Step*** *section)*

21. We only need the Ch_rings_Clip layer and cnty13 layer, so right-click the other layers and select Remove. You should have only two layers remaining, Ch_rings_Clip and cnty13. Turn off cnty13 and leave only Ch_rings_Clip turned on.

22. Open the attribute table for Ch_rings_Clip, and add these three fields to the table by clicking the Table Options button:
Pct60_80, float, precision 16, scale 2
Pct80_00, float, precision 16, scale 2
Chgpct, float, precision 16, scale 2

23. Close the table.

24. Turn on editing tools (right-click in the gray area in the top menu bar), click Editor, and click Start Editing. Set Ch_rings_Clip as the target. Click once on Ch_rings_Clip in the Create Features box on the right side of the screen.

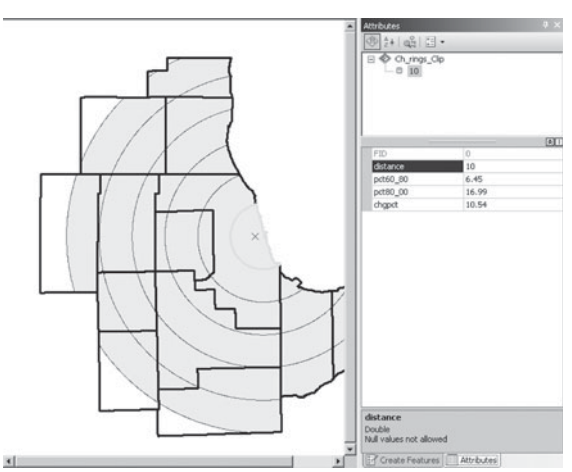


25. Click the Edit tool to the right of the word "Editor."

26. Click the innermost ring (Ring 1) to select it.

27. Click the Attributes tool on the Editor toolbar.

28. Refer back to the table, and enter the percentage values, reading across the table, for each ring.



29. Click the next outer ring, and enter the percentage values, reading across the table, for Ring 2.
30. Repeat this procedure for the remaining rings.
31. When finished, click Editor, click Stop Editing, and answer Yes to save your edits.
32. Right-click Ch_rings_Clip, and select Open Attribute Table. Your table should like the following:

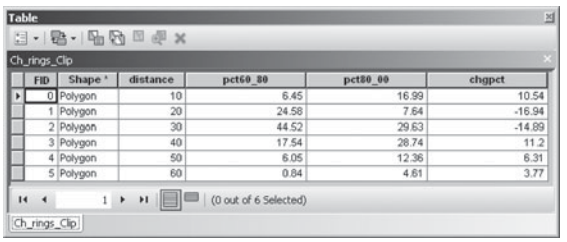
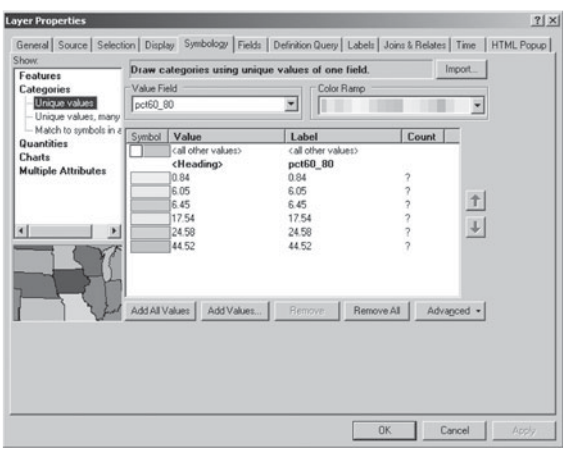
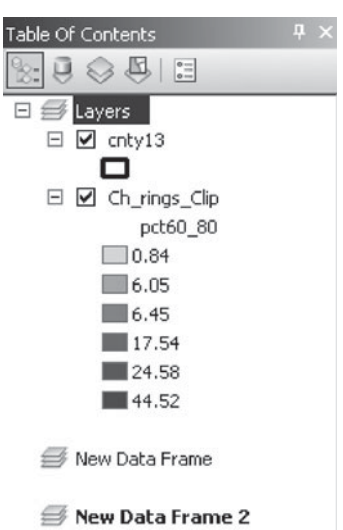


Table
Ch_rings_Clip
FID | Shape * | distance | pct60_80 | pct80_00 | chgpct
0 | Polygon | 10 | 6.45 | 16.99 | 10.54
1 | Polygon | 20 | 24.58 | 7.64 | -16.94
2 | Polygon | 30 | 44.52 | 29.63 | -14.89
3 | Polygon | 40 | 17.54 | 28.74 | 11.2
4 | Polygon | 50 | 6.05 | 12.36 | 6.31
5 | Polygon | 60 | 0.84 | 4.61 | 3.77
(0 out of 6 Selected)
Ch_rings_Clip

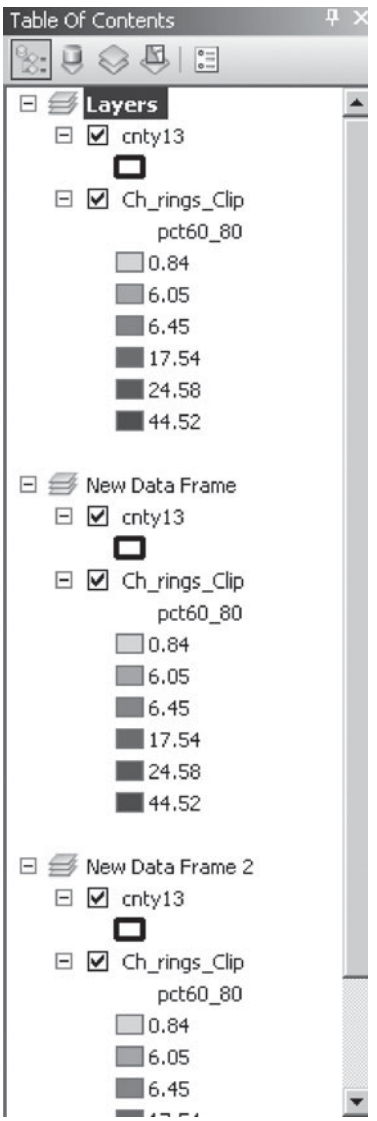
33. Close the table.
34. Right-click Ch_rings_Clip, and select Properties. Click the Symbology tab.
35. Select Categories, and select Unique Values. In the Value Field dropdown list, select Pct60_80, clear the <all other values> check box, click Add All Values, and click OK.


Layer Properties
General | Source | Selection | Display | Symbology | Fields | Definition Query | Labels | Joins & Relates | Time | HTML Popup
Show:
Features
Categories
Unique values
Unique values, many
Match to symbols in a
Quantities
Charts
Multiple Attributes
Draw categories using unique values of one field.
Import...
Value Field
pct60_80
Color Ramp
Symbol | Value | Label | Count
<all other values> | <all other values>
<Heading> | pct60_80
0.84 | 0.84 | ?
6.05 | 6.05 | ?
6.45 | 6.45 | ?
17.54 | 17.54 | ?
24.58 | 24.58 | ?
44.52 | 44.52 | ?
Add All Values | Add Values... | Remove | Remove All | Advanced
OK | Cancel | Apply

36. Change the colors if you wish by clicking each box individually and selecting colors of your choice (gradations from light to dark are best to correspond to low values ranging to high values). Click Apply, and then click OK to see your results.
37. Click Insert on the top menu bar, and click Data Frame. Repeat by clicking Insert and clicking Data Frame again. You should have the following:

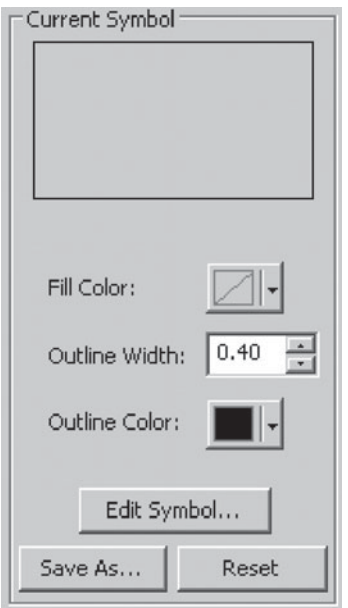


38. Right-click the Layers data frame, and select Activate. Now the original data frame is active. Select the Ch_rings_Clip layer, and hold down the Shift key; then select cnty13. Now that they are both selected, right-click Ch_rings_Clip, and select Copy.
39. Right-click New Data Frame, and select Paste Layer(s).
40. Right-click New Data Frame 2, and select Paste Layer(s).
41. Now all three data frames have the same layers.

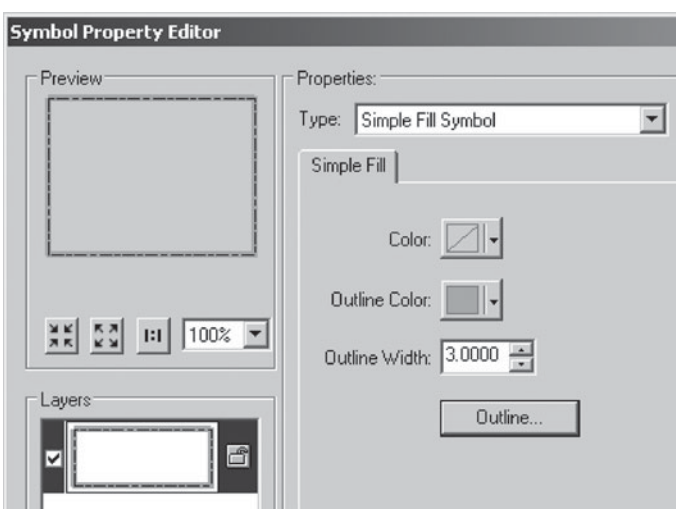


42. Right-click New Data Frame, and select Activate.
43. Right-click Ch_rings_Clip within New Data Frame, and select Properties. In the Properties dialog box, under Fields, select Pct80_00. Click Add All Values, change the colors to be consistent with the Layers data frame, click Apply, and then click OK to see your results.
44. Right-click New Data Frame 2, and select Activate.
45. Right-click Ch_rings_Clip within New Data Frame 2, and select Properties. In the Properties dialog box, under Fields, select Chgpct. Click Add All Values, change the colors to be consistent with the previous two data frames, click Apply, and then click OK to see your results.
46. For each of the data frames, right-click cnty13 in the table of contents, and select Properties. Click the Symbology tab and then the Symbol box.

47. In the Symbol Selector dialog box, click the Hollow symbol, and then click Edit Symbol.



48. In the Symbol Property Editor dialog box, click Outline.

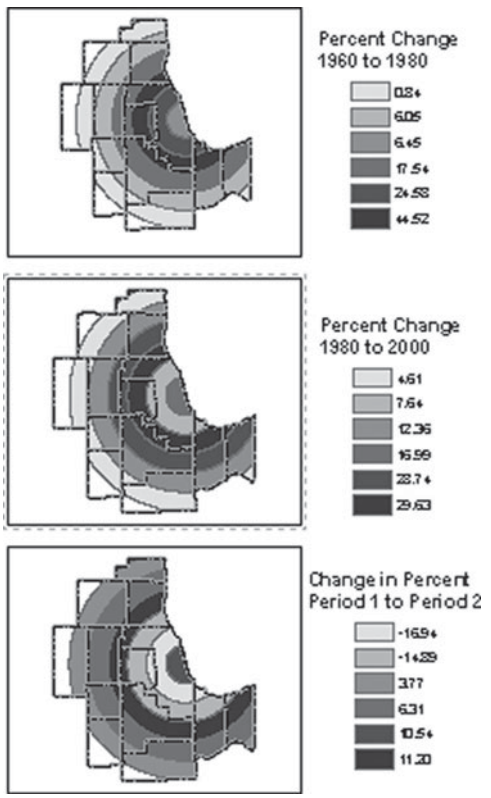


49. In the Symbol Selector dialog box, scroll down and choose the symbol for county boundaries. Click OK on each box as you return to the map.

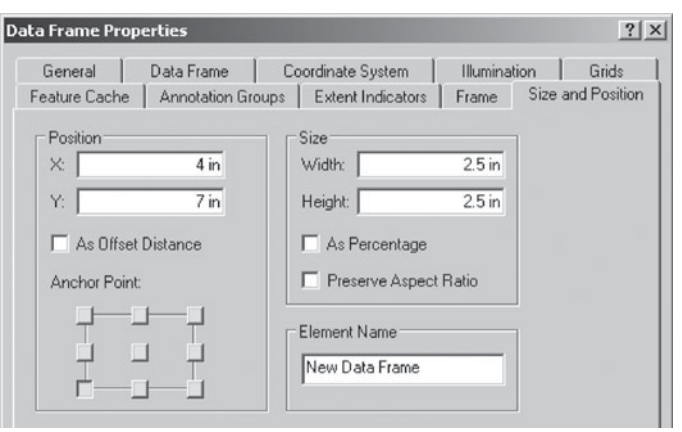
50. Click the cnty13 layer name in the table of contents, and drag the layer to the top position above Ch_rings_Clip. Make sure the cnty13 layer is now turned on.

51. Once all of the data frames have the same format with county boundaries on top and are turned on, you can select Layout View from the View menu to compose a map for printing.

52. Within Layout View, you can see multiple data frames at a time. All three data frames are there; you just need to reposition them in the following format with associated legend and text. Note that the legends are ordered by the magnitude of values, not by the ring order.

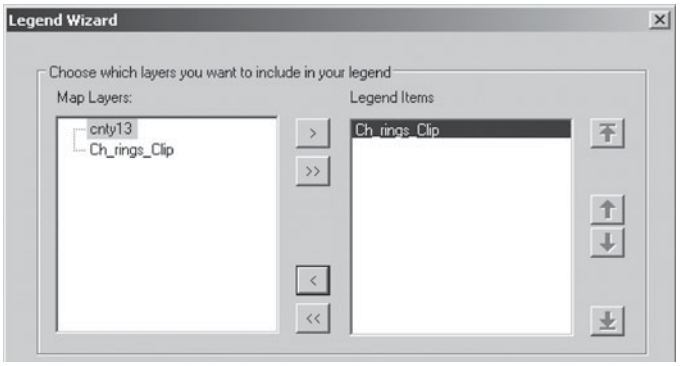


53. To achieve a format similar to the one just shown, you can standardize the *x,y* position of the lower left corner of each data frame and assign a standard height and width by right-clicking a data frame, selecting Properties, and clicking the Size and Position tab.



54. In the preceding example for the Layers Frame, the size includes a width of 2.5 inches and a height of 2.5 inches, the *x* position is set to 4 inches, and the *y* position is set to 7 inches. Note that the anchor point that is depressed is the lower left; this is the *x,y* position you are specifying on that corner of the page. The New Data Frame should include the same width and height, as well as the same *x* position. However, its *y* position should be set to 4. The New Data Frame2 *y* position should be set to 1.

55. Make the Layers data frame active, and click Insert to insert a legend. In the first dialog box, make sure that the only legend item is Ch_rings_Clip. To remove cnty13, select it in the right column, and use the arrow to move it to the left column.



56. Click Next in the next several dialog boxes, and click Finish.

57. Now double-click the selected legend. Click the Legend tab and replace the title with:

Percent Change

1960 to 1980

Click the Items tab, and in the right column, double-click Ch_rings_Clip, click Properties, click the General tab, and clear the Show Layer Name and Show Heading check boxes. Click Apply, and then click OK. Click OK as you exit back. Reposition the legend to a suitable spot.

58. Repeat Steps 55 through 57 for New Data Frame. The legend should read:

Percent Change

1960 to 1980

1980 to 2000

59. Repeat Steps 55 through 57 for Data Frame 2. The legend should read:

Change in Percentage

Period 1 to Period 2

60. Click File, and select Print to print the final map (alternatively, you can click File, and select Export Map to export it to one of your favorite image formats).

61. Exit ArcMap.

ArcGIS Short Essay: In your essay, review the readings, including the relevant chapter sections on sprawl and the urban fringe. Discuss the expansion of Chicago from 1960 to 2000. What were the major ring trends over the 40 years, and why did they occur? Discuss the strengths and weaknesses of the method employed to monitor outward expansion of the urban fringe and sprawl for the Chicago region. Explain how the three maps can be used in support of the hypothesis that the urban fringe is analogous to a bow wave.

Challenge Step: Substitute the manual editing steps 21-31 with the following general steps:

1. Use the statistics tool to find the sum for six rings;
2. Add a new field pct60_80 in Ch6080_dis;
3. Calculate pct60_80=sum for each ring/sum for six rings;
4. Join the table to ch_rings_clip using FID or distance as the common field.
5. Repeat the steps for ch8000_dis.
6. Add a field called chgpct in Ch_rings_clip and calculate it=pct8000-pct6080.

When finished with the above proceed to Step 32 to complete the exercise.

Log in to www.mygeoscienceplace.com for ArcGIS Exercise data files, Google Earth™ Exercise kmz files, RSS feeds, flashcards, web links, and self-study quizzes to enhance your study of urban core and edge city contrasts.

CHAPTER

10 Environmental Problems

The city comprises parts of the natural and human environment. It contains biota and ecosystems; consumes energy, water, and food; is a part of man-made food chains; emits pollutants and wastes; and faces challenges to manage these flows and processes. This chapter focuses on the role of environmental problems in the city. That is a large role because worldwide over half of the population lives in urban areas and a higher proportion of man-made environmental problems occurs in cities.

The role of urban geography is to elucidate the spatial aspects of urban environmental flows—for example, solid-waste locations, transport of pollutants, water supply, energy consumption, and land conversion on the metropolitan fringe. The chapter examines the major concepts and processes of the urban environment. The earth's natural cycles include the carbon cycle, water cycle, and energy flows. The chapter also presents the natural ecology concepts of species, habitat, and ecosystem. Humans have intervened in all of these cycles and systems, with benefits and detriments. One large concern for this century is the role of cities in global climate change and in turn its impact on cities. Other important pollution types are examined.

The chapter considers population growth as the fundamental cause of urban environmental problems. Urban population is growing on a worldwide basis, both by natural increase and by net migration from rural to urban areas. Population change in a city from time i to time j may be represented by the formula:

$$P_j = P_i + B - D + M + A$$

where P_j is the population at time j, P_i is the population at time i, B is births from time i to time j, D is deaths from time i to time j, M is net migration into the city from time i to time j, and A is population added by net annexation from time i to time j. City growth is uneven because the change components—B, D, M, and A—change over time. They also differ among nations. Rural-to-urban migration and urban-to-urban migration vary a lot depending on factors examined in Chapter 6. Urban fertility and urban mortality vary among countries depending on multiple sociodemographic and health factors. Annexation varies based on local, regional, and sometimes national political, legal, and growth aspects.

Added to the effects of population growth is a long-term trend toward per capita increase in the consumption of energy and products, as well as more damaging environmental impacts from consumption. This can be understood by the model known as IPAT with PC (Kates, 2000; York, Rosa, & Dietz, 2003). IPAT is an abbreviation for impacts, population, affluence, and technology (York et al., 2003), while PC stands for population and consumption (Kates, 2000; York et al., 2003). The IPAT/PC model is stated as $I = P \times C/P \times I/C$, where I is impacts on the environment, C is consumption, and P is population. Significantly, the consumption per capita ratio in this model increased by about five times in the 20th century (Kates, 2000) and is continuing to grow in the 21st century. The ratio of impacts per unit of consumption has also grown. For example, much more carbon dioxide per consumption has been released into the atmosphere during the last 50 years than previously. More research is needed to understand the numbers for this equation worldwide and among countries (Kates, 2000; York et al., 2003).

Water, essential for plant and animal life on earth, follows a water cycle. Water is evaporated and transpired by plants into the atmosphere, where it forms clouds and is precipitated back to earth. Once on the earth's surface, it flows through surface streams and groundwater in the earth back to lakes and oceans where it starts the cycle again. Other precipitation is taken up by plants,

photosynthesized and transpired, also starting the cycle again. The city is subject to this water cycle, through which it must satisfy its need for adequate water supply and quality. Many cities, mostly in the developing world, suffer from water scarcity and contamination, as well as from oversupply leading to urban flooding.

Other environmental aspects are urban wastes and their management, energy resources, and air pollution. "Analyzing an Urban Issue: Asthma in Chicago" examines the relationship of asthma to air pollution in Chicago.

A key question for urban geography is where, within the cities, the negative environmental impacts are felt. Unfortunately, poor, deprived, and, often, minority populations absorb most of these impacts. This imbalance and the need to rectify it are referred to as *environmental justice*. The complex issues and causes of these inequalities can stem from conscious policy or accidents of history. A case study focusing on the crisis over solid waste disposal in New York City exemplifies the complexities of environmental issues.

Smart growth and new urbanism are current planning approaches that attempt to plan and develop cities and urban areas more sensibly and in better concert with nature. Successes are best achieved through cooperation between business and government.

10.1 CONCEPTS AND PROCESSES OF THE URBAN ENVIRONMENT

This section presents basic concepts of ecological, water, energy, and carbon cycles that underpin life on earth, including human life in the city. These cycles are modified by the city's high concentrations of economic activity, built infrastructure, and human population. Finally, the complexities of urban environmental processes can be modeled by complex simulation models, which are useful tools.

The earth's energy is derived originally from the sun. The sun's energy that arrives at the earth can be utilized directly by plants for photosynthesis, can be deflected back out of the atmosphere, can serve to warm the planet, or can be captured by solar energy facilities to generate heat and electricity. The other major forms of energy are *fossil fuel energy,* extracted from decomposed organic compounds stored in the earth, such as coal and petroleum; *hydro energy,* coming from harnessing the flow of water; *solar energy*, collected directly from the sun; *wind energy,* coming from transforming the mechanical movement of wind masses; *geothermal energy,* derived from hot water and steam in the earth; and *nuclear energy,* coming from harnessing the nuclear reactions of uranium and other elements and compounds. Most of this energy originally came from solar energy hitting the earth. In the natural environment, energy cycles are essential because all plants and animals require energy. Man-made energy systems vastly increase the utilization of certain forms of energy, such as fossil and nuclear energy, but bring with them environmental and economic costs.

Energy is measured in watts; 1 watt represents the power produced by a current of 1 ampere across a potential difference of 1 volt *or* 1/746 horsepower. A kilowatt is 1,000 watts; a megawatt is 1 million watts; and a gigawatt is 1 billion watts. Worldwide, the world primary energy demand on an annual basis in 2007 was 136.4×10^6 gigawatt hours, or an average of 0.0206 gigawatt hours per capita (International Energy Agency, 2008). Of this, 67 percent is consumed by people in urban areas.

There is a finite amount of water on the earth and in its atmosphere. As seen in Figure 10.1, water moves through a *water cycle*. It leaves the earth and enters the atmosphere through *evaporation* and *transpiration* from photosynthesis occurring in vegetation and falls back to the earth's land and ocean surfaces through *precipitation*. Some water runs off into oceans and other water bodies, some is frozen in glaciers and other ice forms, and some *infiltrates* into the soil, where it might be absorbed by plants or reach the groundwater, also called the zone of saturation, which stores large amounts in *aquifers* or *reservoirs*. *Groundwater* is water inside the earth that is supplied by the infiltration of surface water through the soil into underground aquifers or reservoirs. From the groundwater, it comes again to the surface through natural springs and man-made wells. The man-made interventions in this cycle include surface water diversions, dams, flood-control channels, canals, pipelines, and reservoirs, many of them essential for contemporary societies. However, these facilities might damage ecosystems, leading to urban flooding, climate change, and loss of natural waterways. The last occurs when the natural courses of rivers and streams are altered through damming and water diversions. New York City's water reservoir in Central Park is shown in Figure 10.2 (see page 310).

Water supply is commonly measured in *acre-feet*. One acre-foot is the amount of water volume in an area of 1 acre by a depth of 1 foot.

Mexico City provides an urban example of the importance of the water cycle. Underlying the metropolitan area is an immense aquifer. Today, the metropolitan area's 19.4 million residents receive 1.6 million acre-feet of water per year, with 70 percent of their water supply coming from the aquifer, 2 percent from surface sources inside the metropolitan area, and 29 percent pumped up to Mexico City from the surrounding Lerma and Cutzamala Basins (Ezcurra, Mazari-Hiriart, Pianty, & Guillermo, 1999; LEAD International, 2004). The immediate challenge is obtaining enough water to keep up with the population growth because the aquifer has a large, but limited capacity. Another short-term problem is the hazard of spillage of contaminated wastes that do not receive sewage treatment and are transported out of the city in surface canals (Ezcurra et al., 1999; LEAD International, 2004). More underground sewage drainage canals are being built, but their leakage is even more dangerous because they leak more deeply in the soil and might endanger the aquifer over time. The serious longer-term problem is the potential contamination of the aquifer (Ezcurra et al., 1999; LEAD International, 2004; Mazari, & Mackay, 1993; Mazari-Hiriart, De la Torre, Mazari, Menzer, & Exequiel, 2001). The surface subsidence (sinking) of the ground level of Mexico City allows waste and contaminants to migrate downward, where they might seep into the aquifer (LEAD International, 2004). The challenge for the metropolitan governments is to improve the management of the water supply and sewage disposal and treatment and to recognize much more than they have the natural water cycle of the Mexico City Basin.

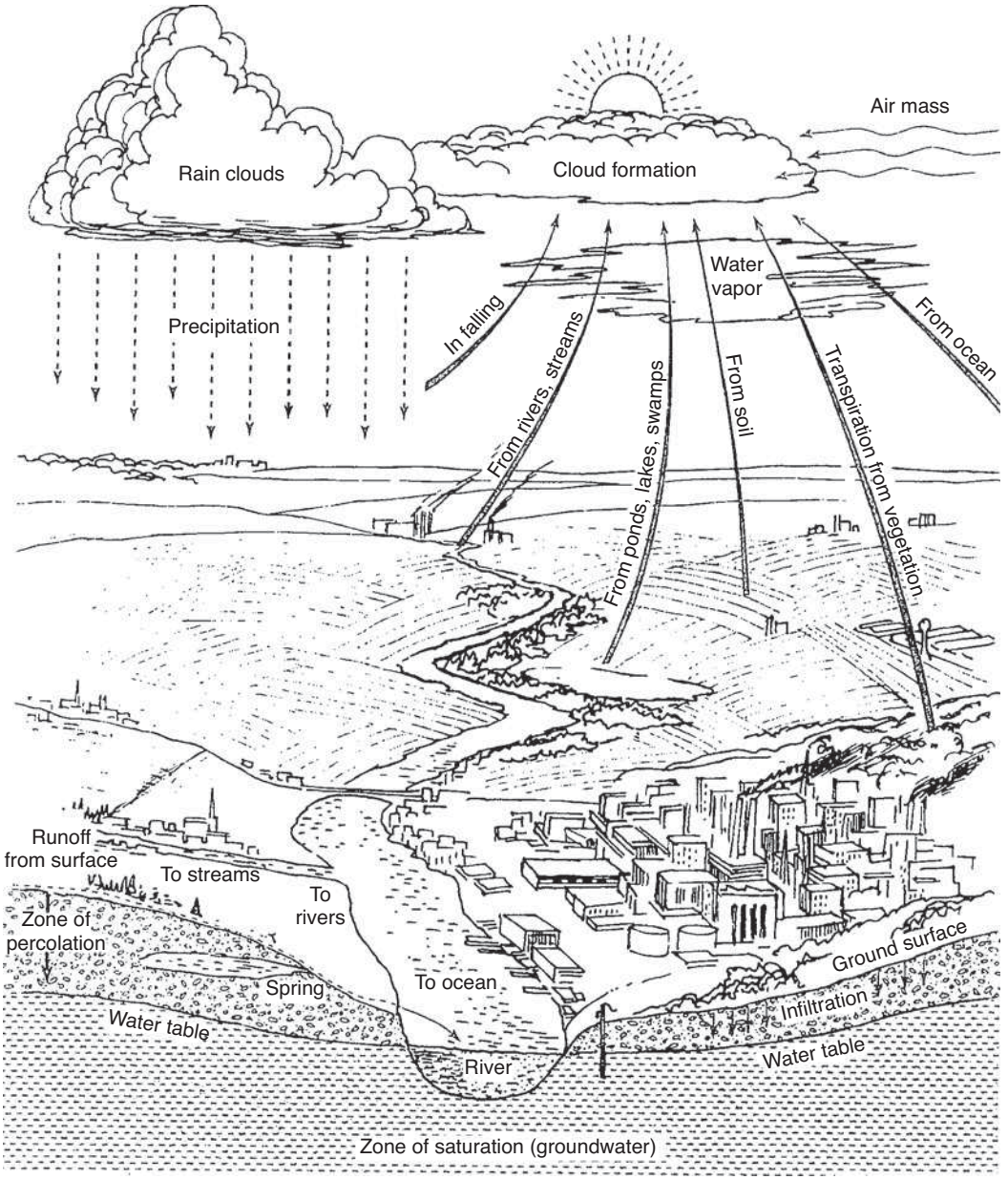


FIGURE 10.1 The water cycle. *Source:* Chiras, Daniel D.; Reganold, John P.; Owen, Oliver S., NATURAL RESOURCE CONSERVATION: MGMT FOR SUSTAINABLE FUTURE, 8th, © 2002. Printed and Electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, NJ.

There are many chemical cycles, in which chemicals circulate from the atmosphere to the earth's land surface to the subsurface, eventually returning through underground or surface flows to the ocean and back to the atmosphere. The most important one for urban geography is the *carbon cycle* (see Figure 10.3), in which carbon dioxide, respired from animals and microorganisms, is absorbed during photosynthesis by plants and other organisms. When plants die, carbon dioxide is processed as part of the decomposition, and carbon is recycled into the soil, where over a long period some of it might become embedded as fossil fuel. The fossil fuels eventually can be mined for fuel use in factories and transport, which releases carbon dioxide into the atmosphere. Live or dead plants can be burned, releasing carbon dioxide. Other plant remains might end up in ocean sediments or be absorbed by phytoplankton in the ocean. They will eventually release carbon dioxide that moves upward and is released into the atmosphere. This cycle has led to increased levels of carbon dioxide in the atmosphere, which underlies the major problem of climate change.

In the nitrogen cycle, nitrogen gas in the atmosphere circulates through the earth in the form of soil nitrates and eventually returns to the atmosphere (Townsend & Howarth, 2010). N_2 gas is inert and comprises 78 percent of the atmosphere. It is converted by specialized bacteria into soil nitrates. Biological waste and remains can also be converted by other bacteria into soil nitrates. In addition, N_2 can be converted by industrial fixation into soil nitrates or fertilizer. Eventually, the soil nitrates are denitrified by bacteria, releasing nitrogen dioxide and nitrous oxide back into the atmosphere. Nitrous oxide is a greenhouse gas that contributes to climate change, although it is not as important as carbon dioxide.

FIGURE 10.2 Water reservoir in Central Park, New York City. *Source:* Peter Arnold, Inc.

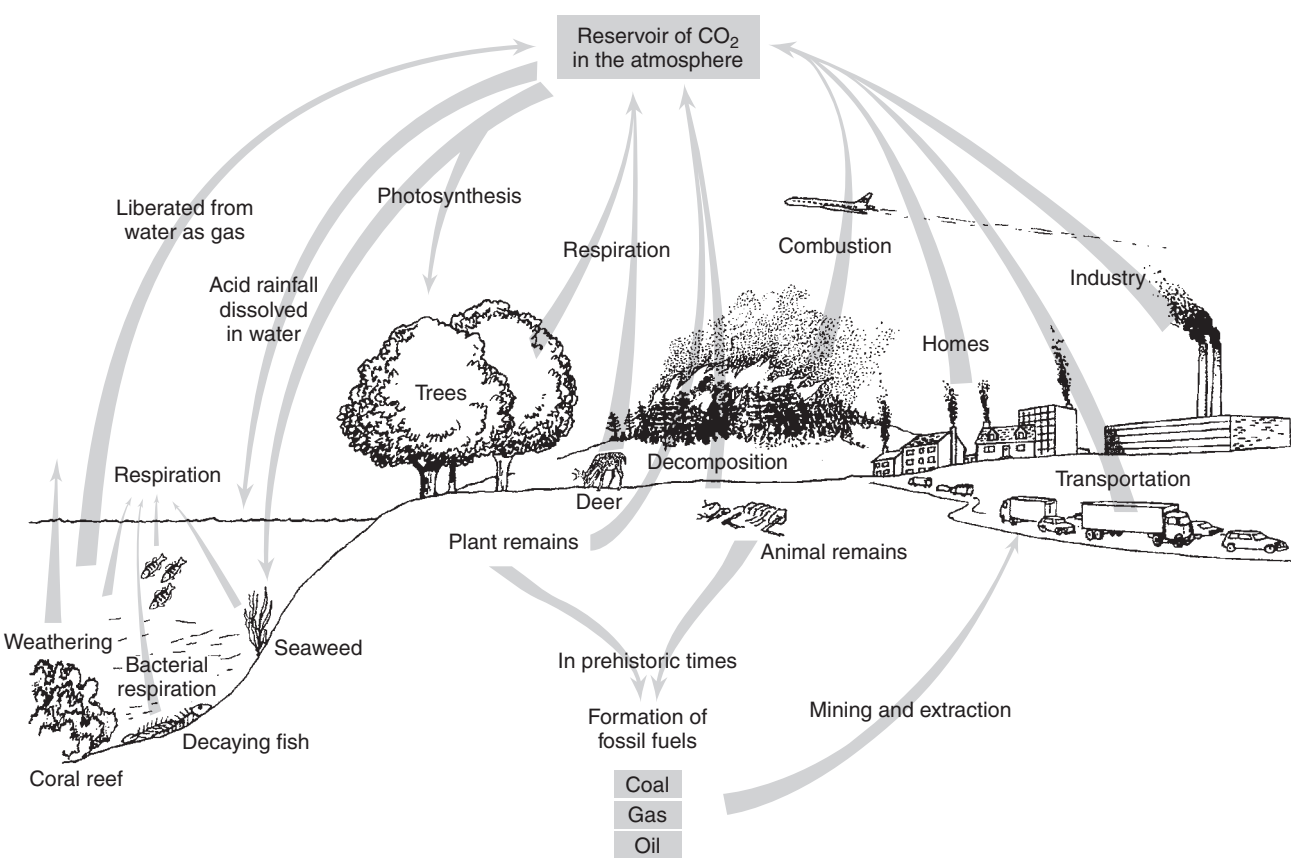


FIGURE 10.3 The carbon cycle. *Source:* Chiras, Daniel D.; Reganold, John P.; Owen, Oliver S., NATURAL RESOURCE CONSERVATION: MGMT FOR SUSTAINABLE FUTURE, 8th, © 2002. Printed and Electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, NJ.

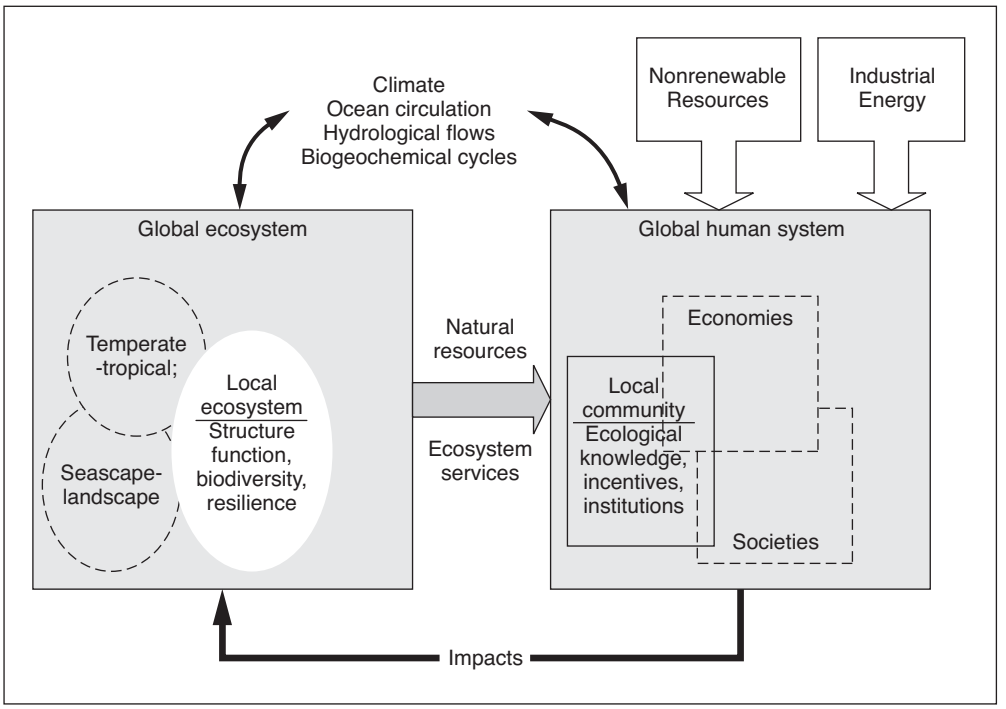


FIGURE 10.4 Combined system of humans and nature. *Source:* Modified from Folke, C. 1999. "Ecological principles." HANDBOOK OF ENVIRONMENTAL AND RESOURCE ECONOMICS. J.C.J.M. van den Bergh (ed.) Cheltenham, UK: Edward Elgar. Reprinted by permission of Edward Elgar Publishing Ltd. PP. 895–911.

Plants and animals are part of biological systems that have long-term natural interactions. All organisms are classified into different *species,* which are defined as groupings of animals, plants, or microorganisms of a single type. Single type implies similarity of appearance and the ability to produce fertile offspring. Estimates are that the earth contains between 3.6 million and 13.6 million species, although only 1.75 million have been identified and classified. Species have developed through the process of evolution and could be subject to genetic changes over time, as well as extinction. Species occupy particular land or aquatic areas, known as habitats. A habitat depends on food sources, environmental factors, behavior including mating, and other factors. Taken together, groups of plants and animals in a region constitute an ecosystem, which is defined as a grouping of animals, plants, and other organisms interacting with the environment and with each other so that the group of species perpetuates itself. Examples of ecosystems include tropical rainforest, tundra, and desert.

The scientific discipline of ecology studies organisms in the environment, systems that govern their interactions, their population growth and decline, and the recycling and energetics of biota. The discipline is essential to understanding urban environments. The city also has natural biota and ecosystems—natural cycles and processes, often modified, which support its plant, animal, and microbial life. The city depends on inflows of food and other natural substances from local and more distant ecosystems and also releases an outflow of substances, waste products, and pollutants that impact ecosystems. An example is acid rain, which stems primarily from industrial outputs in urban areas, but impacts broad areas and their biota.

Figure 10.4 shows the interactions of the global natural ecosystem on the left and the global human system on the right. The global ecosystem can be divided geographically into regional ecosystems such as those in the temperate region and the tropical region. A regional ecosystem can be further divided into local ecosystems (e.g., a forest ecosystem in Oregon). The global ecosystem is impacted by the hydrological, energy, chemical, and other cycles, as well as by weather and ocean circulation. The global human system, on the right, includes the global economy and societies such as nations and groups of nations. These large human units receive environmental inputs into their economies that include energy and resources, and they produce outputs. Among the inputs to the global human system are food, plant and animal products, energy, chemicals, and nonrenewable natural resources. Its outputs are processed foods, purified water, wastes, agricultural products, fertilizers, irrigation water, greenhouse gases, pollutants, nuclear wastes, and various other items that impact the natural system. Societies have environmental policies, knowledge, and institutions that influence the inputs and outputs. At a smaller scale are local human communities, such as provinces, counties, tribal groups, and metropolitan areas, which also have individual environmental inputs and outputs that influence local ecological policies, knowledge, and institutions.

All told, this is a dynamic set of natural and human systems that form highly complex interactions and flows. More than half of the global human system is urban. Hence, understanding the components of this complex world model is important for urban geography. For several decades, research groups have worked at establishing dynamic models of the

global environmental system. Among the well-known models were the systems dynamics models that originated in the late 1960s at the Massachusetts Institute of Technology (MIT; Forrester, 1969, 1971) and the Meadows models (Meadows & Meadows, 1972; Meadows, Meadows, & Randers, 1992). The systems dynamics models commonly gave predictions that extended for 100 or more years.

In recent years, the global crisis of climate change has been assessed by climate models encompassing the entire earth. The Intergovernmental Panel on Climate Change (IPCC), founded in 1988 by the United Nations, has been a leader in utilizing complex climate models to assess impacts of greenhouse gases on the global climate. These models examine the physical aspects, exposure and risk of socioeconomic and natural systems, and effects of hypothetical mitigation alternatives. For its two decades of climate change study, modeling, and results, the IPCC was awarded the Nobel Peace Prize in 2007. The IPCC's hundreds of modeling experts continue to refine these models, allowing for the study of regional geographic impacts, such as on the Arctic or on Africa (IPCC, 2007; Pachauri, 2007).

IPCC climate change model predictions are dependent on a complex set of assumptions, including demographic and economic magnitudes and growth rates, population age structure, magnitudes and consumption rates of natural resources, atmospheric and oceanic processes, and food consumption rates. The models commonly make predictions for the entire 21st century. The accuracy of such models in predicting out many decades is low, but the models are nevertheless good tools to use to understand dynamic process interactions under given conditions.

In long-range city planning, some cities have employed similar types of models for the local metropolitan area and its surrounding region. An example is the Blue Ring plan for Seattle, which is a 100-year vision developed to preserve the city's quality of life (City of Seattle, 2002a, 2002b, 2009; Olson, 2003). The former Green Ring was established in 1903 by the famous planners Frederick Law Olmsted and John Charles Olmsted. It established loops of wooded parkways and parks and other green open spaces. During the subsequent 100 years, this long-term vision worked fairly well because the many projects, developers, and builders adhered to the long-term plan. The Blue Ring plan focuses on the further enhancement of open spaces, with an emphasis on an inner ring around the central downtown consisting of city open spaces and water connections, which is where many U.S. cities are crowded, are often dilapidated, and lack open space (City of Seattle, 2002a, 2002b, 2009). Public open space is modified by land conversions. The plan and land use model were completed in 2003 and involved inputs from many stakeholders, including developers, neighborhood groups, and public interest groups and boards. The planning was done by CityDesign, a city government office that in 2004 became part of the city's Planning Division (City of Seattle, 2009; Olson, 2003). The model showed that a serious challenge in achieving open spaces is the high land values and lack of available land plots for parks in the downtown. However, the planners discovered that street rights of way constitute about 40 percent of the project's land and that some streets can be converted into pedestrian walkways or be subject to traffic restrictions at certain times of day.

The developers of the plan walked and bicycled around many neglected land parcels to add insights and refinements to the planning. The Blue Ring plan is intended to set a long-term vision for use of open spaces, prior to the initiation of many infrastructure and development projects anticipated over the next decade and the next 100 years, such as redeveloping the downtown waterfront, improving transport, and revitalizing infrastructure and neighborhoods. The plan is an example of an environmental model developed by a city that can be applied for a very long range strategic purpose (City of Seattle, 2002a, 2002b, 2009).

10.2 CLIMATE CHANGE AND CITIES

The earth's climate is changing due to human factors. In recent decades, the rate of change has increased, and it is a major concern for the world in the 21st century, including for cities. The most significant change stems from alterations in a group of gases in the atmosphere known as greenhouse gases, which include water vapor, carbon dioxide (CO_2), methane, nitrous oxide, and ozone (National Academy of Sciences, 2008). Increases in the concentrations of greenhouse gases can result in the warming of the earth's surface and the lower part of the atmosphere. The explanation, as shown in Figure 10.5, is that solar radiation enters the atmosphere, with some of it being reflected back into space. Most of the solar radiation is absorbed by the earth as heat, and some of the earth's heat is released back into the atmosphere and mostly into space. However, as more greenhouse gases are present in the upper atmosphere, more infrared energy, a source of heat, is trapped in the atmosphere, eventually exceeding the naturally occurring level. The added heat serves to warm the atmosphere and the earth's surface.

A concern raised by this cycle is that the human population is producing elevated amounts of carbon dioxide, which is implicated as a major cause of global climate change. The upward trend in the atmospheric level of carbon dioxide is shown in Figure 10.6, which plots, over the past 150 years, the world's carbon dioxide concentration and human population and, over the past 75 years, the world's industrial production (Genske, 2003). Carbon dioxide concentration is growing at a rate somewhat slower than industrial production, but faster than population growth. Figure 10.7 (see page 314) shows carbon dioxide being emitted into the atmosphere by an industrial plant.

The CO_2 levels in the atmosphere have increased from 290 parts per million (ppm) in 1800 (Genske, 2003) to 387 ppm in 2009, a 33 percent rise in two centuries (National Oceanic and Atmospheric Administration, 2010). If CO_2 emissions peaked prior to 2015 and dropped afterward, the earth's CO_2 concentration would stabilize between 445 and 490 ppm, a range that would imply an average earth surface temperature rise of 2 °C (3.6 °F) (Pachauri, 2007). This is an optimistic scenario given that many energy and infrastructure projects are already contractually "firmed up" for the next 20 to 25 years. Even though this optimistic scenario of a 2 °C temperature increase would

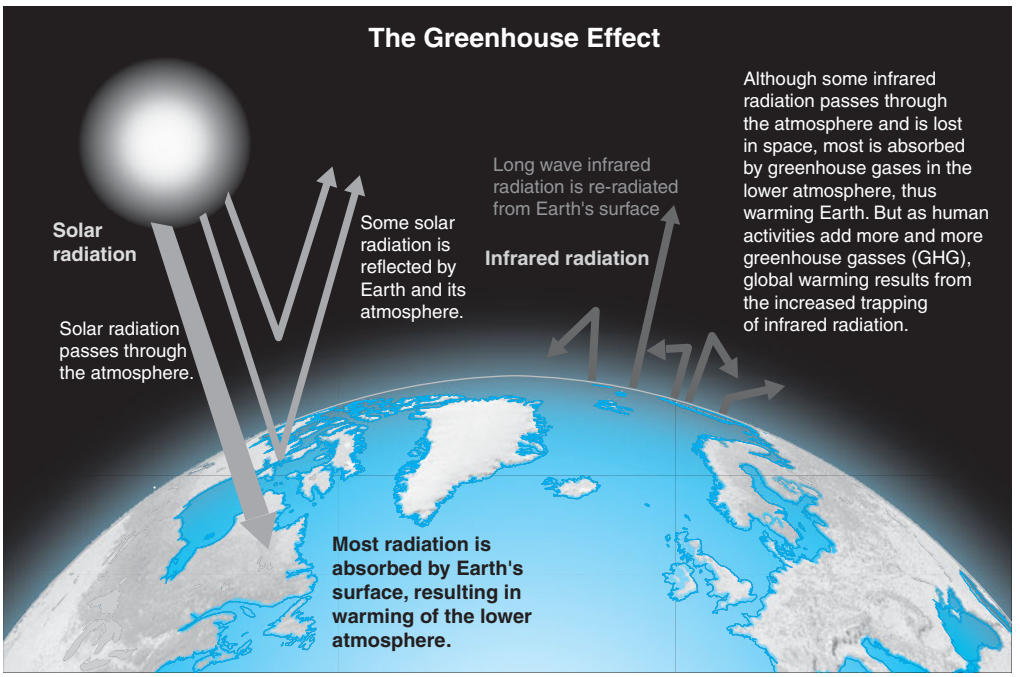

The Greenhouse Effect
Solar radiation
Solar radiation passes through the atmosphere.
Some solar radiation is reflected by Earth and its atmosphere.
Long wave infrared radiation is re-radiated from Earth's surface
Infrared radiation
Although some infrared radiation passes through the atmosphere and is lost in space, most is absorbed by greenhouse gases in the lower atmosphere, thus warming Earth. But as human activities add more and more greenhouse gasses (GHG), global warming results from the increased trapping of infrared radiation.
Most radiation is absorbed by Earth's surface, resulting in warming of the lower atmosphere.

FIGURE 10.5 The greenhouse effect leading to amplified warming of the earth. *Source:* Rowntree, L., Lewis, M., Price, M., and Wyckoff, W. (2012). *Diversity Amid Globalization* (5th ed.). Upper Saddle River, NJ: Pearson. Figure 2.10, p. 54.

not feel much hotter to an individual person, the marginal effects on many climatic and natural systems and phenomena would result in moderate to vast changes, since chemical, climatic, and ecological systems would be triggered in many circumstances and the systems might react with large effects. The impacts include melting of glaciers, changes in meteorological patterns, alteration of ocean currents, changes in ecological systems, stress on certain species leading in some cases to extinction, and changes in crop patterns and productivity. The melting and retreat of glaciers in polar and mountain regions have become evident in recent decades (Larmer, 2010; Orlove, 2009). This melt contributes to sea-level rise and alters the timing and size of flows of fresh water, both of which impact cities. In the world's greatest mountain range, the Himalayas, glaciers are retreating, so, although there is a temporary increase in water flows over several years or decades, in the long run less water is glacially stored, resulting in reduced water flow for billions of people in the cities of India and South Asia (Larmer, 2010). Glacial melting in Antarctica is shown in Figure 10.8.

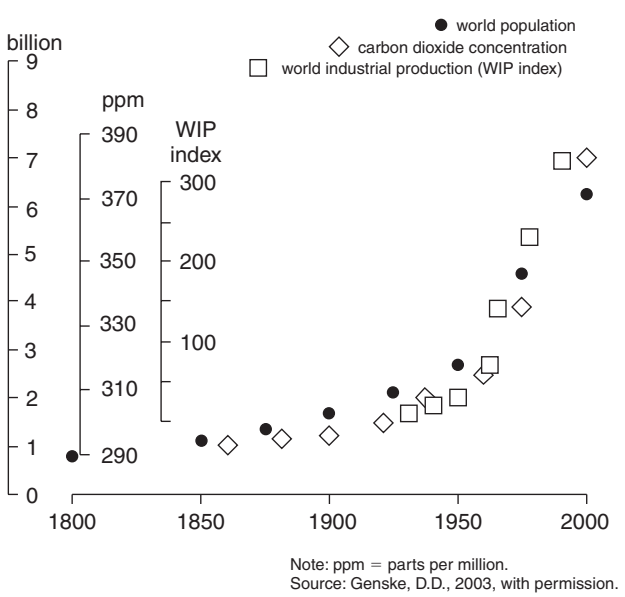


FIGURE 10.6 World levels of carbon dioxide, population, and industrial production, 1850–2000. *Source:* Genske, Dieter D.D. (2003). URBAN LAND: DEGRADATION, INVESTIGATION, REMEDIATION. Berlin, Germany: Springer-Verlag. Reprinted with permission of Springer Science+Business Media. (after data from Meadows, et al. 1992).

This chapter considers the impacts on cities of the expected outcomes of climate change in the 21st century. In the final chapter, national and metropolitan policies to prevent or mitigate climate change impacts on cities are discussed. Since the environmental and economic systems are large and complex, no one today can predict accurately all the impacts and outcomes. However, careful analysis has been done by such agencies and groups as the International Energy Agency, the U.S. National Academy of Sciences, and the United Nations' IPCC. As noted earlier, the significance of the IPCC's research on and reporting of climate change was honored in 2007 with the Nobel Peace Prize (Pachauri, 2007), shared with Al Gore.

The impacts of global warming that will affect cities include rising sea level, loss of some islands, an increase in severe storms, climate-change-related human migration, reduced water supply, health impacts, and extinctions of species (IPCC,

FIGURE 10.7 Emission of carbon dioxide from industrial plant. *Source:* Getty Images.

FIGURE 10.8 Melting of glaciers in Antarctica.

TABLE 10.1 Expected Impacts of Global Climate Change on Cities in the 21st Century

Impact Category	Examples of Effects on Cities
Rising sea level	Potential flooding of very low lying cities such as those in Bangladesh and western Europe. Potential loss of small islands, including their urban areas.
Water resources	Possible losses of mountain and glacier-fed water supply. Economic pressures, especially in rapidly growing developing-world cities, to replace lost supply with water of lower quality.
Weather	Increase in the frequency and intensity of severe weather events such as hurricanes, threatening cities in coastal and nearby regions. Urban heat islands likely to be of longer duration and hotter.
Health	Rise in death rate from infectious diseases. Higher respiratory disease rate from worsening air pollution. Mortality from more severe storms.
Migration	Movements of "climate refugees" out of or into certain urban areas.
Loss of species and natural sections of cities	Change in the composition of forests in urban areas. Species reductions and extinctions in cities.
Transportation	More fuel efficient vehicles. Increased pedestrian and bicycle traffic. Growth in low-carbon public transportation. Expanded telecommuting.
Economy	Changes in economic exchange in response to regulations that favor improved climate through cap and trade and other means.

Sources: Abatzoglou, J., DiMento, J. F. C., Doughman, P., and Nespor, S. (2007). "Climate-change effects: Global and local views." In *Climate Change: What It Means for Us, Our Children, and Our Grandchildren,* edited by J. F. C. DiMento and P. Doughman, pp. 45–64. Cambridge, MA: MIT Press; International Panel on Climate Change. (2007). *Climate Change 2007: Synthesis Report*. Geneva, Switzerland: Author. Available at http://www.ipcc.ch; National Academy of Sciences. (2008). *Understanding and Responding to Climate Change.* Washington, DC: Author; Pachauri, R. K. (2007). *Acceptance Speech for the Nobel Peace Prize Awarded to the Intergovernmental Panel on Climate Change.* Available at http://www.ipcc.ch.

2007; National Academy of Sciences, 2007; Pachauri, 2007), are shown in Table 10.1. Some cities might benefit from some changes, but the overall impacts will be adverse. The IPCC prediction is that, even assuming the optimistic scenario of CO_2 reduction, average sea level worldwide would rise by 1.3 to 4.6 feet. In low-lying coastal regions such as southern Bangladesh, there would be a huge loss of urban land, leading to hundreds of thousands of "climate refugees," who would need to move to cities or rural areas at higher elevations. Most low-lying coastal cities would have forced residential mobility or out-migration, bringing about the social and economic changes in the receiving urban areas that were discussed in Chapter 6.

As water resources are likely to become scarcer and/or higher priced in some cities, pressure will be exerted for such measures as water conservation, desalination, and water-sharing agreements. Changes in the biota of urban forests and species movement and losses will lead to subtle changes in the appearance of cities, their natural and landscaped areas, and their interactions with nature.

Since cities and metropolitan areas, as well as national governments, will surely respond to these impacts, the economies and lifestyles of cities will change. For instance, vehicle transport will shift to more pedestrian movement and public transport, air pollution will drop as urban energy production shifts to more renewable sources, green architecture will change the appearance of cities, and economic programs to achieve sustainable solutions such as cap and trade or other economic regulations and controls will be implemented. Planning for changes to the human dimensions and the urban way of life are discussed in the final chapter.

Some urban regions are projected to be impacted more than others (DiMento & Doughman, 2007; National Academy of Sciences, 2008; Pachauri, 2007). For instance, cities in the Arctic and Subarctic are already feeling the results of melting ice and rising temperature. Because of its atmospheric, meteorologic, and reflectivity characteristics, the Arctic is subject to climate change at a more rapid rate than other world regions (Pachauri, 2007). Small towns and cities in Alaska increasingly will need to move inland due to ice melting (DiMento & Doughman, 2007). A mixed result of melting will be the sea lanes that are likely to appear across the Arctic. On the one hand, they will enhance the economies of cities in the far north through growing trade and seaports, while they also will threaten some traditional ways of life. In African coastal cities, flooding and erosion of the coastlines are anticipated, but with less economic capability to mitigate the impacts. Advanced nations are not spared. For example, atmospheric temperature rise from climate change should lead to higher ozone at the ground level for many California cities, which heightens the incidence of respiratory illness (DiMento & Doughman, 2007).

An urban example involving the carbon cycle would be the hypothetical proposal to add a new semiconductor manufacturing plant in Albuquerque, New Mexico. Semiconductor plants consume a lot of energy, so the new plant would add to the demand on the New Mexico power grid, which is currently powered 77 percent by coal and natural gas power, 15 percent by nuclear power, and 8 percent by wind energy (PNM Resources, 2010). Even though New Mexico's major utility is becoming more conscious of reducing greenhouse gas emissions and has joined former President Clinton's global initiative for efficient energy, the manufacturing plant's energy requirements would add to the carbon dioxide, nitrous oxide, and sulfur dioxide emissions of the fossil power plants, as well as to the demand for cooling water for fossil and nuclear plants. Carbon dioxide and nitrous oxide emissions would contribute to global climate change. The carbon dioxide would enter the carbon

cycle shown in Figure 10.3 and would have a wide variety of potential soil, oceanic, and biological effects. For instance, CO_2 taken in by plants and animals would later lead through their decomposition to carbon compounds in the soil, subsurface, and oceans that could be released as CO_2 in the future. The semiconductor plant would also produce toxic substances that would need to be disposed of in waste sites, so as not to be carried in other ecological cycles not discussed.

Because of such complex systems and impacts, the urban challenge of climate change is expected to continue throughout this century. The final chapter will address ways that cities and the regions and nations that support them can try to prevent or mitigate the likely serious consequences of climate change.

10.3 LAND USE

This section explores land use in the urban environment. Urban land is allocated to industrial, commercial, residential, park, and other uses. There are many forms of land ownership and regulation throughout the world. Land is often regulated by city, county, and other government authorities. For instance, zoning in the United States is done mostly by local municipalities and sometimes by counties. However, states and the federal government might designate for their own uses state or federal lands within metropolitan areas, even superseding local zoning. In cities of the developing world, land zoning is often less strictly imposed (DeSoto, 2003). Although land ownership is usually observed worldwide, in some cities, such as Sao Paulo and Mexico City, squatters can often lay claim to peripheral land just by occupancy (Pick and Butler, 2000).

Land use must be viewed as dynamically changing. What is the present land ownership and zoning of the land parcel where you are now reading? Think what it might have been a century or two centuries ago. Over time, urban land can undergo development, be in active use, become neglected, and even be abandoned, especially in older areas of large cities, which in the United States are often near the city center. Abandoned, deteriorating industrial sites called *brownfields* are eyesores and often sources of contamination, but can be regenerated at a cost into relatively clean and habitable *greenfields*. Besides industrial land degradation, other causes of urban land deterioration are use in disposal of wastes, resource extraction, natural disaster, abandonment, and warfare, which is illustrated in Figure 10.9 by the devastation of Hiroshima after the atomic bomb was dropped on August 6, 1945. At the edge of growing cities, there is pressure to convert rural or agricultural land into urban land ready to be developed. This agricultural land conversion process has advantages and disadvantages.

FIGURE 10.9 Hiroshima, Japan, after the U.S. atomic bombing of August 6, 1945. *Source:* Corbis/Bettmann.

Land cover is a static representation of the land surface. For instance, an aerial or satellite photo shows land cover, as does a geographic information system (GIS) map layer of land use, like some of the GIS layers used in the Google Earth lab exercises earlier in the book.

In the United States, residential land has standards for suitable habitation. However, beyond the minimum thresholds, there are benefits referred to as *amenities.* They include such things as water frontage, scenic views, convenience to parks or cultural sites, trees, and home gardens. *Disamenities,* features perceived as adverse, include noise, susceptibility to flooding, and adjacency to industrial pollution, waste-disposal sites, power plants, and other toxic areas. Amenities favor the comfort of residents and higher land values, whereas disamenities have the opposite effects. There are cultural differences in the perceptions of what constitutes a residential amenity or disamenity. For example, although oceanside location is regarded as a big plus in the United States and Europe, it is viewed as a hazard in Accra, Ghana, because of occasionally inclement weather conditions, reducing real estate value (Meyer, 2002).

There are interactions between residential land-use patterns and the natural environment. The design and layout of residential land affect air pollution, natural habitats, and hydrological systems and emphasize or restrict open spaces (Meyer, 2002). The trade-offs become very evident for land being altered by urban sprawl at the periphery of cities. As seen in Chapter 9, changes in peripheral land layout depend heavily on the amount of and locations for automobile transport access, the extent of agricultural land consumption, and access to water.

10.3.1 Brownfields and Greenfields

A brownfield is an abandoned, neglected, or underutilized commercial land site for which redevelopment is retarded by a perception, not always accurate, of environmental degradation or contamination. Examples of brownfields are abandoned factories, transport facilities, and service stations; neglected waste-disposal sites; vacant warehouses; and uninhabited, rundown buildings. By contrast, a greenfield is defined as a land site with natural ecological functions such as groundwater renewal and carbon cycling that has an ample level of biodiversity. The territory of brownfields and greenfields is small compared to overall urban area, but they are significant as locations for particular types of urban development. The U.S. Conference of Mayors estimated in 2003 that there were 21,000 brownfield sites in the 210 largest U.S. metropolitan areas (Sierra Club, 2003). Many sites are contaminated, some at toxic levels. In fact, some brownfields appear on the list of Superfund sites, places designated by the U.S. government as the most toxic in the nation. Brownfields are often located in urban core areas that were formerly industrial, but are sometimes on the periphery where there are abandoned mines and industrial plants (Genske, 2003). For instance, in Britain, abandoned mines are located in small- and medium-sized towns northwest of Birmingham, and in the former East Germany, there are many abandoned mines filled with debris that have not been cleaned up. A brownfield with a derelict tank in the Ruhr district of Germany is shown in Figure 10.10.

FIGURE 10.10 Brownfield with derelict tank in Ruhr district, Germany. *Source:* Genske, D.D. (2003). *Urban Land: Degradation, Investigation, Remediation*. Berlin, Germany: Springer–Verlag. Photo provided to authors by Dieter Genske, 2004.

Commonly a brownfield lacks people or organizations willing to take responsibility to clean it up. Further, the abandonment might attract crime, require social services, and reduce the value of nearby property. A goal for brownfields is to clean them up through redevelopment and convert them into beneficial uses. An example of brownfield rehabilitation is an abandoned gas station in Trenton, New Jersey (see Figure 10.11), that was renewed to become a new firehouse (see Figure 10.12). The costly process involved not only surface demolition and construction, but also subsurface cleanup of residual ground contamination. The U.S. Environmental Protection Agency (EPA) points to the benefits of redevelopment, including the following:

- Economic improvement of the urban core;
- Avoidance of urban sprawl by emphasis on redeveloping the center;
- Centralized and compact industrial facilities, which in turn lower the need for pollution monitoring;
- Reuse and recycling of abandoned properties; and
- Change of brownfields into greenfields.

A number of steps are being taken in different countries to revitalize brownfields. One of the strongest national mandates

FIGURE 10.11 Brownfield before rehabilitation: Abandoned gas station, Trenton, New Jersey. *Source:* City of Trenton.

is in Britain, where the government legislation requires that by 2015, 60 percent of new development must take place in brownfields. Progress is being made, but it is too early to know the outcome. In the United States, an exemplary city in cleaning up brownfields is Pittsburgh. In 1960, the city was among the most polluted in the United States. As the city's coal and steel industries were largely eliminated, many zones were cleaned up and revitalized. As shown in Figure 10.13, in the 1930s, the section of the city center bordering the Monongahela and Allegheny Rivers contained transport and industrial facilities that were

FIGURE 10.12 Rehabilitated brownfield from Figure 10.11: Firehouse, Trenton, New Jersey. *Source:* City of Trenton.

FIGURE 10.13 Downtown Pittsburgh in the 1930s. *Source:* Corbis/Bettmann.

eventually abandoned. By 1990, this section was renewed with a park, statuary, new bridges, and other useful features and amenities (see Figure 10.14).

It is possible to examine brownfields on a smaller scale. The EPA identified two buildings on Grand Street in Hoboken, New Jersey, as so contaminated with mercury, asbestos, and other substances that they were put on the U.S. Superfund list (U.S. EPA, 1997). They were put through the process of revitalization by the following steps: mercury decontamination and recovery, asbestos abatement, demolition of the two buildings on the site and disposal of any contaminants, disposal of contaminated soils, and groundwater monitoring for any recurring contamination.

10.4 WATER RESOURCES

Water resources are essential to the functioning of any city. Besides residential supply, water is utilized for commercial and industrial uses, recreation, parks, cooling water for power plants, and other purposes. In 2000, the amount of water withdrawn each day in the United States from surface and ground sources was 1,225 gallons per capita, while the global average was 465 gallons per capita (FAO Aquastat, 2010). The most water is withdrawn for agricultural use, particular in dry climates, but in the advanced economies of the United States and Europe, the greatest water use is for industry, especially for water cooling for energy production (Clarke & King, 2004). In the United States in 2005, an estimated 147 gallons per capita were consumed daily for public use, excluding power generation (Kenny, Barber, Hutson, Linsey, Lovelace, and Maupin, 2009). Of this, 85 gallons per capita were for domestic use, and the rest mostly for public services, such as municipal buildings, fire safety, parks, and pools. Urban domestic users relied almost entirely on the public water supply, while self-supply through wells and cisterns sometimes occurred in rural areas. Worldwide 94 gallons per capita were withdrawn daily for industry use, about half of which was used for hydropower and cooling water (Clarke & King, 2004). A problem is that the developing world is expected to industrialize much more in the next 25 years, leading to much higher demand for industrial water; some estimates indicate such demand will increase by a factor of five. There are many challenges and problems surrounding water resources for cities, including water quality, supply, and management. An associated problem covered in the next section is urban flooding—that is, coping with too much water. This section first reviews in more detail the urban water cycle and how it relates to land uses in the city and then turns to water quality and pollution.

The water supply cycle was shown in Figure 10.1. However, that simple diagram did not allow for water pollution. A more complete picture of the water cycle in a typical urban system

FIGURE 10.14 Downtown Pittsburgh in the early 21st century. *Source:* The Image Works.

reveals many sources of water pollution (see Figure 10.15). The figure is at the scale of a city and its surroundings, similar to Figure 10.1. The urban water supply and pollution sources are shown in the figure on the left, whereas those for agriculture are on the right. The sources of water for the city are streams, rainfall, and groundwater. Potential pollution sources occur at each step along the way. The water being evaporated into the atmosphere contains pollutants from urban air pollution, industry, and power plants. When this water returns locally in the form of precipitation, it might be acid rain or have other pollutants. The city's sewage treatment plant releases nutrients and dissolved oxygen into the river body, which is likely to increase biological contamination of the river. Pollutants are released into the groundwater due to a variety of causes, including leakage from landfills and sewer lines, pollutants generated by vehicles that infiltrate the soil, storm water infiltration, and outfall leakage from sewage treatment plants. The agricultural uses might affect the water flows for metropolitan areas because agriculture is often intensive around the urban fringes.

This urban water system is highly complex, with many diverse flows and pollution sources. Nature can interfere randomly with parts of the system through the weather and soil erosion processes. It is difficult to model because major parts of it are underground, in water bodies, and in the atmosphere.

Water pollution in cities impacts human health and disease, as summarized in Table 10.2. This table reveals the real threats of water pollution for cities (Wok, 1996; Meinhardt, 2010; EduGreen, 2010). An underlying factor in urban water pollution problems is the sheer size of city populations, especially in the largest urban areas such as New York and Los Angeles. Twenty million people produce directly or indirectly a huge amount of waste each day, small amounts of which find their way into the consumption portion of the water system. Pollutants tend to be more concentrated in the freshwater of an urban system, which makes up less than 1 percent of all water flow, fresh and saline.

Groundwater is often a major supply source for cities. For instance, Mexico City is principally dependent on water stored in its underground aquifer. Cities need to be concerned about the potential pollution of their groundwater supply. Solid waste eventually decomposes into a liquid waste called leachate, which infiltrates into the groundwater where it can be an insidious pollutant. Only a quarter of the wastewater receives treatment, and leaking pipes cause it to filter through ground cracks into the main aquifer supplying the city (Clarke & King, 2004). Likewise, hazardous and toxic wastes can infiltrate the groundwater. When groundwater becomes polluted, it is often a long-term problem to restore it because direct intervention is not possible inside the earth. Cities need to make a conscious effort to protect their groundwater supplies over the long term, which might involve measures such as protecting the location of wellheads from underground pollutants.

10.4.1 Water Supply

Another key issue in urban water resources is *water supply,* the provision of sufficient water for consumption by residents and companies. Water supply comes mainly from freshwater bodies such as rivers, streams, and lakes, but it can also be provided by man-made irrigation canals and by rainfall collected in high-precipitation areas. A more modern technological source is *desalination,* or the desalting of seawater (Lange,

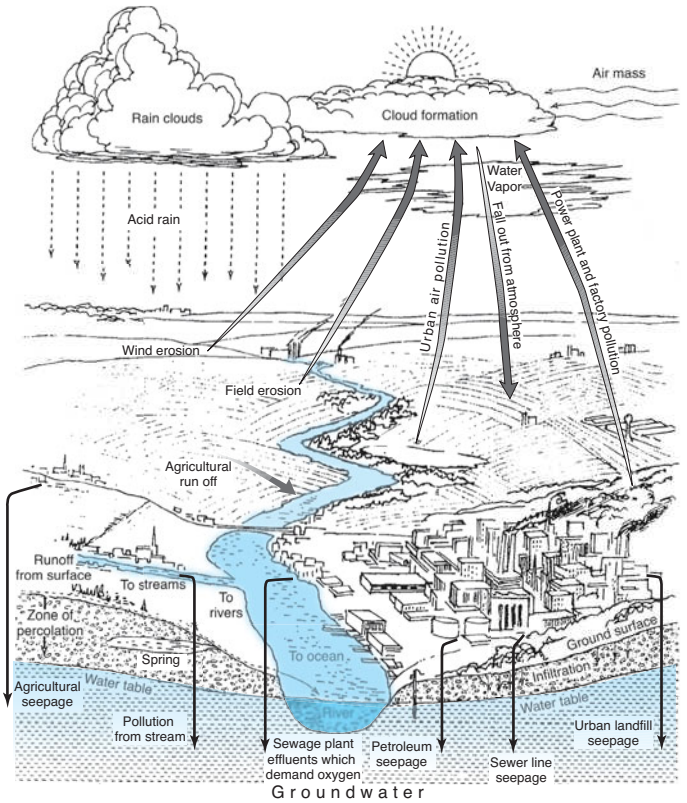


FIGURE 10.15 Water cycle in a typical urban system. *Modified from Source:* Chiras, Daniel D.; Reganold, John P.; Owen, Oliver S., NATURAL RESOURCE CONSERVATION: MGMT FOR SUSTAINABLE FUTURE, 8th, © 2002. Printed and Electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, NJ.

TABLE 10.2 Water Pollution Impacts on Human Health and Disease

Type of Pollutant	Sources and Impacts on Human and Biological Health and Disease
Organisms carrying disease	Bacteria, viruses, and protozoa are released by domestic sewage and by human feces. Leads to a variety of diseases including of skin, ear, eye, nose, throat, intestinal, and respiratory problems. Stagnant water can be habitat to breed insects, parasites, and microorganisms leading to disease spread particularly in tropical locations.
Sewage and waste that demands oxygen	Domestic and poorly treated municipal sewage leads to release of natural organic chemicals which are decomposed by microorganisms leading to oxygen depletion. This process called eutrophication leads to loss of biota and interruption of ecosystems.
Toxic inorganic chemicals and minerals	Inorganic chemicals are released by manufacturing and chemical plants; pesticides flow in agricultural and residential yard runoff into water bodies. Groundwater and landfills are other sources. Chemicals such as arsenic, asbestos, copper, fluoride, lead, mercury, nitrates and numerous others potentially cause skin, circulatory, gastrointestinal, kidney, liver, cancer illnesses. Many of the inorganic chemicals and pesticides also harm fish and other biota.
Synthetic organic chemicals	These chemicals issue from factories, petroleum refineries, leaching of landfills, leaking gas storage tanks, and PVC piping. Among hundreds of organic compounds released are atrazine, benzene, ethylene dibromide, styrene, and vinyl chloride. They lead to a variety of diseases including cardiovascular, cancer, anemia, and reproductive illnesses.
Heating of water	Heat comes from cooling water of power plants and discharges from factories. It causes oxygen reduction in water bodies, which furthers eutrophication. It selectively damages or kills some biota and stimulates others.
Petroleum pollution	Petroleum and petrochemicals can leak out of storage tanks into water supplies. Oil can get into runoff from parking lots and highways and flow to water bodies. Numerous petroleum compounds cause many of the diseases mentioned for organic compounds, for instance benzene causes anemia and elevates cancer risk.
Sediments	Soil erosion leads to release of sediments which are carried through runoff into water bodies. The sediments settle to the bottom of rivers and lakes, harming biota at the bottom.

TABLE 10.3 Water Consumption by Country, Most Recent Data

	Year	Population 2008 (in millions)	Daily Domestic Use in Gallons per Capita	Daily Industry Use in Gallons per Capita
Brazil	2002	192.0	48.6	43.0
Canada	2002	33.3	207.8	729.7
China	2007	1,344.9	36.6	69.6
Egypt	2002	85.6	52.6	39.7
India	2010	1,181.4	34.3	10.4
Israel	2007	7.1	74.3	11.8
Italy	2002	59.6	101.4	204.7
Japan	2002	127.3	99.1	90.0
Mexico	2002	108.5	96.4	30.4
Russia	2002	141.4	66.7	197.2
South Africa	2002	49.7	61.2	11.8
United States	2007	311.7	153.4	517.3

Note: Per capita model estimates are based on total population, municipal, and total water withdrawals from the year given in the table column.

Sources: FAO Aquastat. (2010). "Aquastat main country database." FAO's Information System on Water and Agriculture.

2010). Desalination facilities are present in 150 nations and are increasing in use; by 2016, it is predicted to add 13 billion gallons daily to the worldwide water supply (Lange, 2010).

Table 10.3 shows domestic and industrial water consumption for several nations in 2000 (FAO Aquastats, 2010). For municipal use, Canada, the United States, Italy, and Japan have higher levels of per capita use, ranging from 99 to 208 gallons per day. Nations with the most daily industry use are Canada, the United States, Italy, and Russia, all advanced economies with significant industrial capacity. By contrast, at the lower range for both use types are India, with 34 municipal gallons and 12 industrial gallons per capita daily; South Africa, with 61 municipal gallons and 12 industrial gallons per capita daily; and Israel, with 74 domestic gallons and 12 industrial gallons per capita daily. India, South Africa, and Brazil reflect the very low use typical of the developing world—their per capita consumption ranges from 1/7 to 1/20 that of the United States and Canada. Israel is an upper-middle-level economy that is technologically highly advanced in water supply and conservation, so it can support advanced economic needs with minimal supply. Generally, the implication is that metropolitan-area water demands are associated with level of country development.

Four considerations are crucial in planning for future water supply (Vaux, 2002). First, the current *water availability* needs to be thoroughly understood. In the United States, this especially applies to western states and counties facing the limits of water supply (Rogers, 2008; Vaux, 2002), whereas it is less urgent in other states. For instance, there is an increasing struggle in urban southern California and Las Vegas, Nevada, to obtain water. By contrast, in the wetter southeastern part of the nation, Atlanta, Georgia, also has an urgent water supply problem (Vaux, 2002).

Although only 2.5 percent of the world's water is freshwater, the other 97.5 percent has potential for use through desalination (Lange, 2010). In desalination, the salt is removed from seawater, yielding freshwater. Costs are dropping, with newer methods such as reverse osmosis (RO) and promising upcoming methods of forward osmosis, carbon nanotubes, and biomimetics (Lange, 2010). With RO, pretreated and pressurized saltwater is passed through RO membranes, removing salts and other suspended solids (Rogers, 2008). Since the 1990s, the costs of RO have dropped considerably, making desalination economically feasible. The older method of vaporization is based on the boiling of seawater at reduced atmospheric pressure to produce freshwater vapor that condenses. Cities that have successfully built desalination plants include Tampa Bay, Florida, and Singapore. Tampa Bay Water is the public agency responsible for the water supply for Tampa and surrounding communities through a public/private partnership. Of the 182 million gallons per day the agency produces, 25 million gallons come from an RO desalination plant operating since 2003. Initial bugs have been worked out, and the plant has considerably scaled up its capacity (Tampa Bay Water, 2009). The cost of desalinated water compared to that of freshwater will be key in determining how prevalent desalination will be as an urban water supply source, and that cost difference has decreased significantly over the past two decades (Lange, 2010).

Water supply concerns can be alleviated by reducing water consumption through water conservation and water pricing. Water conservation is increasingly practiced by governments, enterprises, and citizens, especially in areas of drought. Technology advances such as drip irrigation, recycling, and wastewater devices such as the modern dry composting toilet have reduced consumption. For instance, in composting toilets in a housing project in a Stockholm suburb, human waste is converted by aerobic microbes into nontoxic organic matter that can be transported to compositing sites with zero water use, while urine is treated to be used as a fertilizer with slight amounts of water (Rogers, 2008). In large metropolitan areas of advanced economies, governments can apply water-pricing mechanisms to lower water wastage. Bad water consumption habits have built up in metropolitan areas where freshwater supply has been ample and its cost low. Some beneficial results from higher water prices are (1) more recycling, (2) reduced loss and leakage in water delivery systems, (3) reuse of grey water for nonpotable uses, (4) drip irrigation, and (5) accumulation of capital investment funds by water agencies to improve

infrastructure (Rogers, 2008). Water consumption is influenced by housing type, housing size, income, consumer behavior, and other demographic and housing attributes, as shown for Barcelona, Spain (Domene & Sauri, 2006).

A second key factor in urban water planning is the extent of *population growth*. In the United States, population continues to increase. As was seen in Chapter 9, most large U.S. metropolitan areas grew moderately from 2000 to 2008. In metropolitan areas where the current water supply is somewhat constricted—such as Los Angeles, San Diego, Phoenix, and Las Vegas—the population factor is especially pressing. From Chapter 1, recall that the Sunbelt population has grown more than 70 percent since 1970 and is substantially located in the urban areas in Texas, the Southwest, and southern California, large parts of which are arid.

Other semiarid or arid areas of the developing world, such as the Middle East, face even worse problems in this century because of rapidly growing populations and severely limited water supplies (Belt, 2010; Rogers, 2008; Roudi-Fahimi, Creel, & De Souza, 2002). The Middle East and North Africa have 6.3 percent of the world's population, but only 1.3 percent of its fresh water supply, so water is critical for many of its countries (Roudi-Fahimi et al., 2002). This has led to political tensions over water. For instance, the Jordan River runs next to Syria, Lebanon, Israel, Palestinian areas, and Jordan, all arid nations. Their claims for the water have resulted in serious disputes that have not yet been resolved and that at times are exacerbated by the region's political confrontations (Belt, 2010; Rogers, 2008). Large river systems in the developing world such as the Yangtze, Ganges, and Nile have uneven flows seasonally and extreme demands. Another issue that confronts developing-world megacities such as Mexico City, Beijing, and Delhi is the falling level and quality of their groundwater basins (Rogers, 2008). In many parts of the world, the combination of expanding population and reduced freshwater supply from climate change points to a century of water crises, many affecting cities.

The third factor for urban water planning in the United States and in some other nations is *old-fashioned institutional arrangements* (Vaux, 2002; White, 2000). Many American water arrangements at the national, state, and local levels were established in the 19th century. For instance, state water laws in the West, known as *prior appropriation* laws, were designed to give long-term rights to farmers, who historically needed firm assurance of water supply to take the risks involved in agriculture. Today, many believe the laws require more flexibility to deal with emerging water scarcities (Vaux, 2002). At the federal level in the United States, the problem is a "slicing" of federal responsibility for water regulation among multiple agencies, which often do not collaborate. As seen in Table 10.4, quite a few large and bureaucratic federal agencies have partial responsibility for water. Interagency coordination for water has varied over the past half century, improving between 1966 and 1982, when the federal Water Resources Council acted as a coordinating body, including with state agencies (Vaux, 2002), and having mixed results since the advent of the Obama Administration, as seen by inclusion of multi-agency water projects in the American Recovery and Reinvestment Act of 2009 but disappointment in federal and state water resource coordination related to the Gulf Oil Spill of 2010 (Water Resources Coalition, 2010).

TABLE 10.4 U.S. Federal Water Agencies and Their Authority

Federal Water Agency	Authority
Corps of Engineers	Flood control and navigation
Bureau of Reclamation	Irrigation and power
Federal Power Commission	Power, including cooling water and water wastes
U.S. Forest Service	Forest management, including water aspects
Soil Conservation Service	Soil conservation and its water aspects

Source: White, G. F. (2000). "Water science and technology." *Environment* 42(1):30–38.

At the state level, some states such as California have emphasized for decades the need for large systems to transport, deliver, and store water. Figure 10.16 shows the vast California water system, which includes the huge California Aqueduct, other aqueducts and canals, rivers and lakes that serve as reservoirs, and the agricultural sump of the Salton Sea. Most of the state's major metropolitan areas are served by this water system, including Sacramento, San Francisco, Bakersfield, Los Angeles, and San Diego, as well as the state's richest agricultural areas of the Central Valley and parts of Imperial Valley (Bourne, 2010; Hundley, 2001). Started in 1960, the California Aqueduct extends for 450 miles. In addition, since 1925, southern California has tapped Colorado River water. However, that tap has now reached its limit. Partly to offset this, southern California water districts completed a water transfer agreement in 2003 to purchase agricultural water for municipal use from Imperial County with the state as water broker, while the county would plug up water canal leakages and restore the Salton Sea, its agricultural runoff body (Dicochea, 2004). Today, the state supports a monumental system of reservoirs and pipelines for supplying water to a location from near and distant parts of the state (Bourne, 2010; Klein, 2007). Although this system was built up and implemented with an early-20th-century philosophy of "water grab," reductions in supply will force emphasis on conservation in the 21st century.

At the metropolitan level, there are local water districts and private firms that provide the vast bulk of domestic water (White, 2000). In some metropolitan areas, such as Los Angeles, the local water districts are largely professional, experienced, and working in concert with each other (Grafton, 2001). A challenge to local water districts is to focus not only on supplying water to the consumer at the demanded amount, quality, and prices, but also on wastewater disposal and other impacts on ecosystems (White, 2000). Water districts and basins will need to realize the limits of watersheds and the diverting of distant water. Rather, they can control demand through regulations and adopt the concept of a water budget (Bourne, 2010; Klein, 2007). New legislation went into effect in late 2009 that mandates that cities reduce water consumption by 20 percent prior to 2020 (Bourne, 2010). However, funding to improve the efficiency of the state's water system will be harder to obtain unless California solves its longtime budget stringencies. Unfortunately, the federal

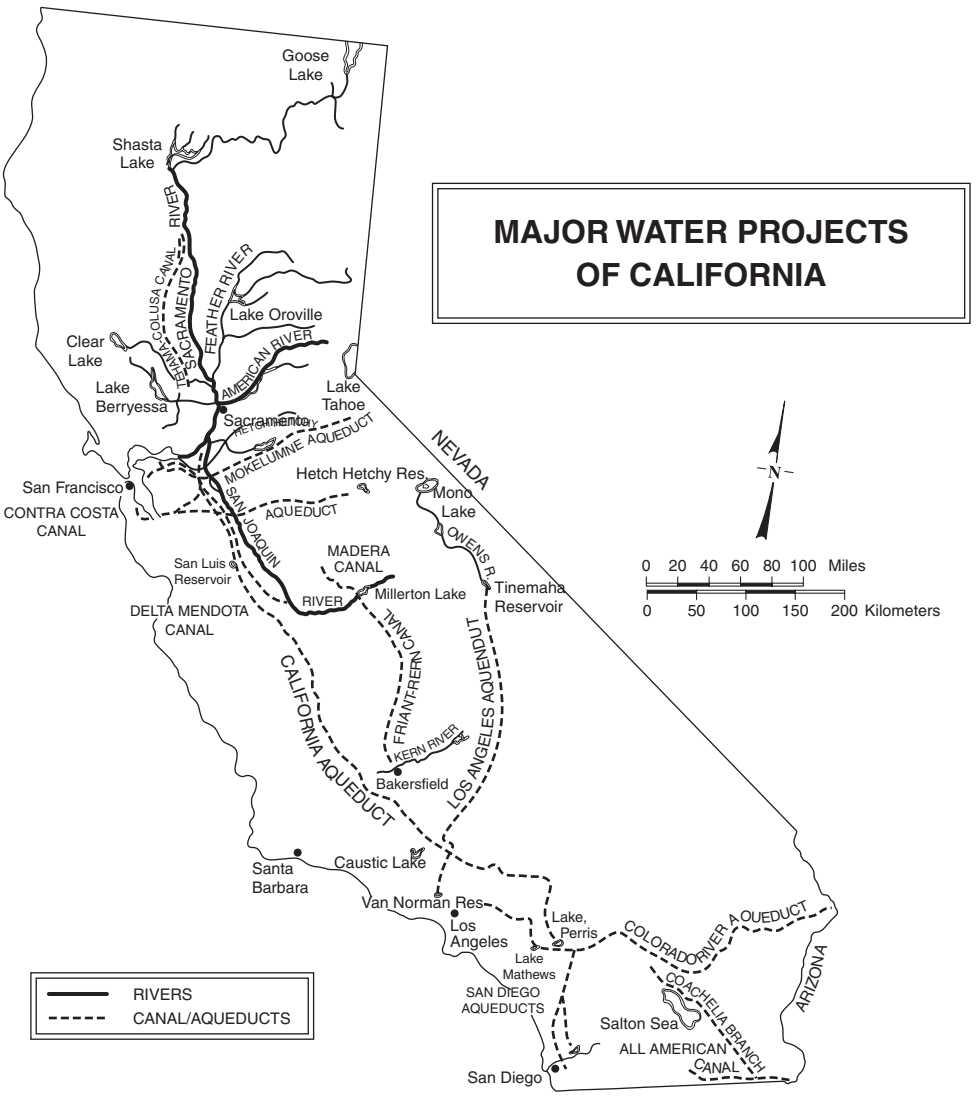


FIGURE 10.16 California water system. *Source:* Hundley, N., Jr. 2001. THE GREAT THIRST: CALIFORNIA AND WATER, A HISTORY (revised ed.). Berkley: University of California Press. Reprinted by permission.

government has not actively encouraged balanced planning by communities. For instance, there have long been federal water quality standards to guarantee drinking water safety, but there are no analogous standards to establish a threshold for wastewater disposal impacts (White, 2000).

Two small urban communities in the Shenandoah Valley in Virginia are good examples of local planning that serves both human consumption and ecosystems. Their water plans include ecosystem impacts. This type of planning can be forward looking, so that it can "help guide the location and quality of further urban and suburban development" (White, 2000, p. 35).

A historical multipurpose program is the Tennessee Valley Authority (TVA), which began in 1933 and is still in operation today. The TVA took a coordinated approach to water and energy with a focus on the entire Tennessee River Basin, considering both consumer demand and ecosystem impacts. It has responded to changes in its political environment, including ramping up power production for World War II industries, building some nuclear plants and then canceling most, and becoming a very efficient producer in the last two decades (TVA, 2004).

Institutional arrangements present in developing nations have strengths and weaknesses. For instance, Mexico City lacks a coherent water development policy. Water supervision is done by strong-willed federal agencies that have limited expertise and often ignore each other (Grafton, 2001), so there is no coherent metropolitan plan. The water production agencies are mining water resources without conserving or protecting them. The environmental programs that do exist have been highly politically charged (Grafton, 2001). This might change in today's political climate in Mexico.

At the same time, governments in some countries are encouraging advanced, balanced designs to conserve and recycle water, as well as to support biota and ecosystems. Figure 10.17 shows the design for a German public building where rainwater from the roof and other runoff water from the building are

FIGURE 10.17 Design to conserve water in a German public building. *Source:* Genske, D. D. (2003). *Urban Land: Degradation, Investigation, Remediation*. Berlin, Germany: Springer–Verlag. Figure 15.16, p. 284.

stored and utilized as gray water to water gardens, flush toilets, and clean the building's solar panels (Genske, 2003).

An approach that has worked in the rapidly growing urban area of Bogotá, Colombia, is to provide water to all its citizens through a public water company. Some functions are outsourced to private firms (Gilbert, 2007). The public entity is well run by trained engineers and managers, resulting in good public feeling about its service, but there is some criticism of the water pricing and the trend toward limited privatization. Overall, this fine water system stands out among large developing-world cities (Gilbert, 2007).

A contemporary institutional arrangement that is beginning to appear is "virtual water." It is the quantity of water necessary to produce food or another product and hence is "embedded" in that item (Rogers, 2009). If two countries are squabbling about water rights, it could be solved by country A getting the water rights and growing agricultural products with the water and by country B getting virtual water rights. When the agricultural product is sold from country A to country B, the latter does not have to pay for the water in the product. An example of this sharing arrangement is the export of water by Jordan to Israel. In 2009, trading worldwide in virtual water totaled over 211 trillion gallons (Rogers, 2009).

The fourth key factor in planning water supply is the movement in advanced nations toward preserving *environmental amenities*. New urbanism, discussed later in the chapter, stresses in part compact growth to preserve natural zones within and near metropolitan areas. However, that approach depends on a supply of water suitable for maintaining substantial biota in natural and agricultural settings, which exceeds the usual level for metropolitan uses. Hence, these ecosystem services require substantial additional water (Vaux, 2002). The usual fix in urban areas is to construct water impoundments, dams, and holding ponds to balance out water scarcity, but they in turn have the downside of physical barriers and other interference with ecosystems. One adverse outcome of this fix tends to be the sharp decrease in wetlands in or near cities (Vaux, 2002).

10.5 URBAN FLOODING

This issue is an extension of the problems of water resources. Although flooding occurs in unperturbed natural environments, it is common in urban areas. In an unperturbed area, high precipitation tends to be absorbed into the ground through the process of *infiltration* down through soil layers. This alleviates the water overload when there is a lot of rain. However, cities replace soil layers with hardscape surfaces. Consequently, natural infiltration is greatly reduced, and instead, the rainwater or snowmelt runs along these surfaces into streams, riverbeds, and man-made channels, with the risk of eventually overflowing them and spilling out onto a floodplain. As seen in Figure 10.18 at the top, the unperturbed watershed has a lot of forest cover, which helps in evenly bringing water to the surface, where it infiltrates downward and eventually ends up in groundwater or in the river system. In the same area with urban development (Figure 10.18 at the bottom), the rainfall is more likely to run off and overflow the channel, potentially leading to a flood. There is reduced soil infiltration due to hardscape surfaces and less groundwater resupply. Another exacerbating circumstance is that the sediment and debris washed into the channel along with the runoff fills in the channel and constricts it. Flood engineers can try to compensate by straightening out channels to increase flow. However, this is usually disruptive to the environment, and it also often transfers the high water flow downstream, where the impacts could be just as damaging.

A developing flood situation can be tracked by a *hydrograph,* a graph showing stream or channel water level versus elapsed time under specific climatic conditions. The example in Figure 10.19 shows two scenarios of level of stream flow, one for the natural setting before urban development and the second after urban development. In the natural setting, there is a delay of 1 day, after which a moderate amount of water has run off or infiltrated into the streambed, leading to a gradual rise in water level to a peak that is still below flood level. With urban development, after only a half-day there is a sharp rise, as much as five times the natural rise, in channel water level to considerably above flood level. It is clear that hydrographs monitoring all the major waterways of a metropolitan area can help government understand and manage the complexity of flood threats.

As an example, the great Mississippi River flood of 1993 covered 9.3 million acres and caused 70,000 people to become homeless, as well as resulting in several deaths. The impact of the substantial rainfall was magnified because of man-made planning mistakes. A large agricultural area adjacent to the Mississippi upstream of the flood had been "enhanced" with extensive man-made channels and piping to increase irrigation. Downstream near St. Louis, the river had been narrowing for

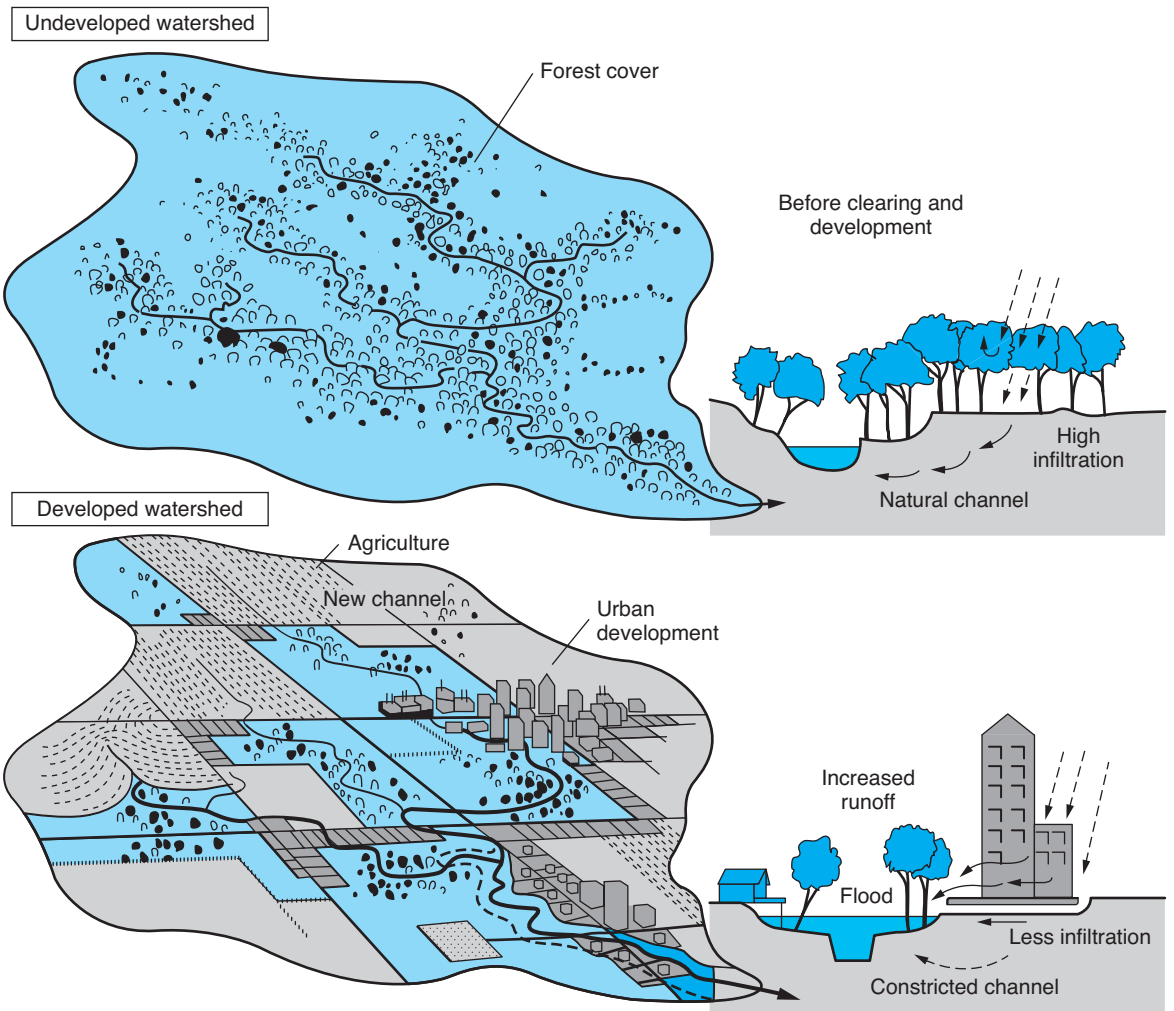


FIGURE 10.18 Runoff and stream flow in undeveloped and developed watersheds. *Source:* Marsh, W.M., and J. Grossa, Jr. (2002) ENVIRONMENTAL GEOGRAPHY: SCIENCE, LAND USE, AND EARTH SYSTEMS. Copyright © 2002 John Wiley & Sons, Inc. Reproduced with permission of John Wiley & Sons, Inc.

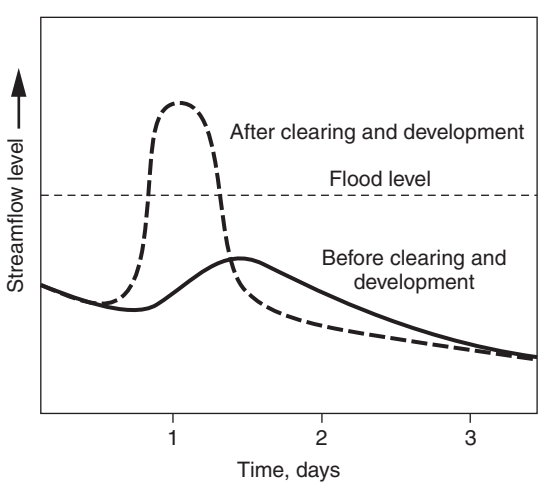


FIGURE 10.19 Urban hydrograph for watersheds in Figure 10.18. *Source:* Marsh, W.M., and Grossa, J. Jr. (2002). *Environmental Geography: Science, Land Use, and Earth Systems*. New York: Wiley.

more than a century because of construction of various river-related facilities. From 1949 to 1969, the river width at this point had narrowed from 4,300 feet to 1,900 feet (Marsh & Grossa, 2004). As the rains increased, large volumes of water flowed rapidly from the upstream agricultural areas, helped by the man-made channels into the river, to the constricted downstream part, where the river overflowed man-made levees and overspilled onto the large floodplain. Disaster ensued. In retrospect, one mitigating measure would have been to construct large storage facilities for storm water. More important would have been better upstream irrigation planning to reduce potentially huge flows.

There are a number of dangers in the longer term for urban flooding. One is that as population grows in the United States, there is more temptation for human settlement on floodplains. Settlement there takes place because the local land-use controls over it are usually minimal. In fact, people are often unaware that they are moving onto a floodplain. Some local governments have been overly optimistic about engineering flood solutions.

CASE STUDY

Wildfire as an Urban Environmental Hazard: San Bernardino County in 2003

A serious urban threat comes from uncontrolled wildfires. From October 25 to 31, 2003, a devastating series of wildfires occurred in six major forested locations in southern California, ranging from the Simi Valley north of Los Angeles to eastern San Diego County. The devastation totaled 700,000 acres burned, 3,346 homes destroyed, and 20 persons killed, including 1 firefighter (Emergency Management, 2004). Authorities speculated that some of the fires were started by arsonists, although evidence and proof are notoriously difficult to establish, as so much is burned (Gorman, Pugmire, & Henry, 2003). This case focuses on the mountain fires in San Bernardino County, the Grand Prix and Old Fires, shown in Figure 10.20. Those fires ended with 162,000 acres burned, 902 homes destroyed, and 4 deaths.

The San Bernardino fire problem stemmed from a number of natural and man-made causes. One was lack of prior fires in this area, so the forest stands had become too thick. Additionally, a southern California drought had dried and stressed the trees. However, these problems were compounded by the bark beetle, a species endemic to the region that had exploded in numbers because of the drought-stressed situation of the trees. This allowed the beetles to bore into the bark of pines more easily to reach their objective, the moist inner core (Sahugun, 2004). Estimates are that, at the time of the 2003 fires, about one-third of the trees in the San Bernardino Mountains were dead or near death from a combination of drought and bark beetle infestation (Sahugun, 2004).

Misguided urban development contributed to another side of the problem. The issue stems from rapid population growth and a history of easy approvals for developers (Martin, 2004). From 1990 to 2000, Riverside and San Bernardino Counties, on the eastern side of the Los Angeles metropolitan area, termed the "Inland Empire," grew by 25 percent, a growth rate that continued at the same rate in the 2000–2010 decade, in spite of the mortgage crisis and real estate slowdown starting in 2007. The mountain area of San Bernardino had a population of 60,000 and was growing at a rate equal to that of the region. Responding to population growth, home developers gained approval for more and more mountain projects with increasingly high densities—and, in some cases, ones that were too tightly packed near forest stands (Tempest, 2003).

There were a number of unfortunate outcomes of this disaster. One involved the need for firefighters to use bulldozers to carve firebreaks around threatened mountain cities, such as Big Bear Lake. On the one hand, this was crucial to saving the city from fire destruction, but in the long term, it was potentially threatening to animal species in the area. This has been a delicate balancing act between reducing imminent dangers to cities and not causing irreparable long-term harm to nature. Another outcome was huge property losses, estimated at $3 billion, of which $1.35 billion was for the San Bernardino fires (Reich, 2003). The only California natural disaster surpassing this loss was the San Francisco earthquake of 1906, which cost $5.7 billion in inflation-adjusted dollars.

The lessons learned were applied by the San Bernardino County Board of Supervisors, which in April 2004 approved strict regulations of future home building in the mountain areas, in spite of strong protests by developers (Martin, 2004). Another lesson was how valuable a GIS was as a tool in mitigating the fires (ESRI, 2004). It was utilized for allocating equipment and resources, mapping fire incident perimeters, providing 3-D mapping of fire situations, developing response plans, displaying public information, implementing public safety measures, and conducting law enforcement, including mapping evacuations, monitoring, and conducting arson investigations. Many aspects of this case carry over to other types of natural disasters in urban areas, including floods, tsunamis, hurricanes, and earthquakes.

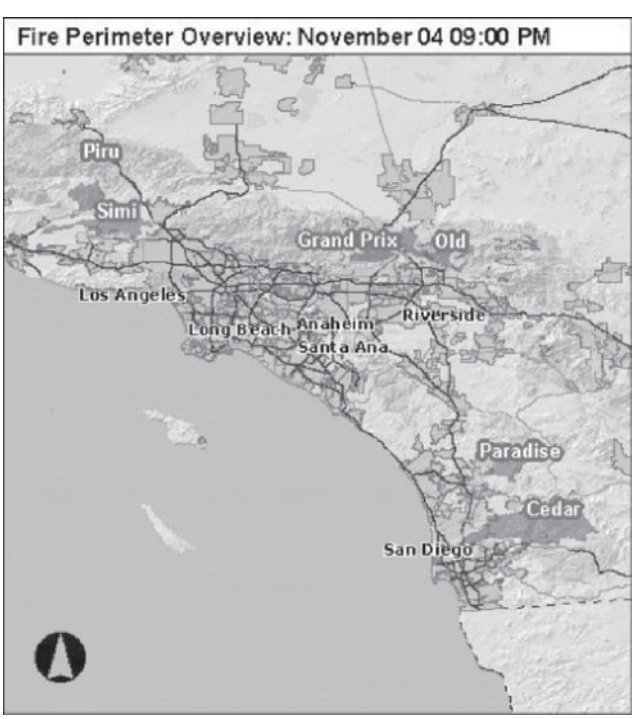


FIGURE 10.20 San Bernardino fires, November 4, 2003. San Bernardino, CA: San Bernardino Mountain Area Taskforce. *Source:* San Bernardino fires, November 4, 2003. Courtesy Esri.

In summary, urban flooding is due largely to man-made alterations that disrupt natural soil absorption systems. Flooding can be planned for and alleviated. Modern solutions should also take into account environmental impacts on the natural systems of floodplains. Some other natural disasters such as forest fires impact urban areas and follow many similar patterns.

10.6 SOLID WASTES

Solid wastes are the solid materials discarded by humans and institutions. This section examines the magnitude of the problem in urban areas, the composition of solid wastes, how they are disposed of, and what pathways the residuals take. Solid waste should not be confused with *sewage,* which is waste solids or liquids that are carried away by a sewer system. *Municipal solid wastes* are discarded materials from households and institutions that are largely disposed of in landfills. A *landfill* is a managed area, usually on the outskirts of a metropolitan area, that receives and stores solid wastes. Detrimental solid wastes, those that can be harmful to humans and biota, are termed *toxic wastes.* Examples are strong acids, petroleum products, and nuclear materials. The federal government has tried to clean up the worst toxic sites through the Superfund, created by the U.S. Congress in 1980. Presently, there are 2,000 Superfund solid-waste sites located throughout the nation, but they are concentrated most heavily in the Boston-to-Washington corridor, California, and the areas surrounding Lake Michigan, areas with numerous defense-related facilities (U.S. EPA, 2010). However, the Superfund has suffered from lack of allocated funds, and so far less than a quarter of sites have been cleaned up.

In the United States in 2008, each resident produced an average of 0.82 tons of municipal solid wastes per year (U.S. EPA, 2009a). The annual U.S. production of municipal solid waste in 2008 was 249.6 million tons. Other types of wastes include industrial wastes, estimated at 1.14 billion tons, and estimated 9 billion tons of solid waste generated yearly from mining and petroleum production (Miller, 2003). As seen in Figure 10.21, on a per capita basis for 1994, average household waste production was about five times the per capita production of solid wastes in Europe (Genske, 2003), a differential that continues today. In Paris, the per capita production of solid wastes was a third that of the average U.S. resident. Per capita solid-waste production is considerably lower in developing nations—calculated to be 2 percent to 3 percent of the U.S. level. Although it is worrisome that consumption patterns increased rapidly in the last century, there is a leveling off in the 21st century. For instance, since 1990, in the United States, per capita municipal solid waste generation has leveled off, and the percentage recycled has doubled from one sixth in 1990 to one third in 2008 (U.S. EPA, 2010). Although there are more than 40,000 possible substances that make up solid wastes, typical European solid wastes (see Table 10.5) consist mostly of paper, compostable material, and plastics.

In the United States, huge solid-waste outputs are disposed of in landfills (73 percent), by burning (14 percent), and by recycling (13 percent). The wastes eventually decompose into leachate, a foul-smelling liquid. Part of the management challenge is to retain the leachate in the landfill so it does not pollute the soil or, worse, the groundwater (Genske, 2003).

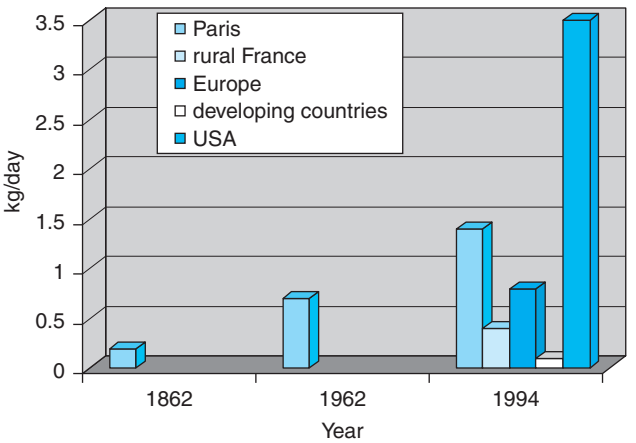


FIGURE 10.21 Average daily household waste production in Paris, rural France, Europe, developing countries, and the United States. *Source:* Genske, Dieter D.D. (2003). URBAN LAND: DEGRADATION, INVESTIGATION, REMEDIATION. Berlin, Germany: Springer-Verlag. Reprinted with permission of Springer Science+Business Media. (after Pichat 1995).

Solid wastes can be carried by runoff into water bodies or get into the air through mismanaged burning. The dangers from improperly buried and contained solid wastes, seen in Figure 10.22, are direct contact by humans, ingestion by animals with potential harm later to humans, air pollution, runoff into water bodies, infiltration into deep groundwater, and movement of waste-generated gas from groundwater into buildings (Genske, 2003).

Recycling is an efficient solution to many solid-waste problems. Worldwide the United Nations estimates that about 35 percent of solid wastes are recycled. In the United States in 2008, 83 million tons of municipal solid waste was recycled, reaching a national-record 32.1 percent recycling rate (U.S. EPA, 2009a). The

TABLE 10.5 Average Composition of Municipal Solid Wastes by Weight in Switzerland in the 1990s

Solid-Waste Component	Percentage
Paper	29
Compostable waste	22
Plastics	15
Ceramics, tiles	8
Natural products (e.g., wood, bones, meat)	8
Composite materials (e.g., appliances)	6
Packing material	4
Glass	3
Metals (e.g., iron)	3
Textiles	2
Total	100

Source: Genske, Dieter D.D. 2003. URBAN LAND: DEGRADATION, INVESTIGATION, REMEDIATION. Berlin, Germany: Springer-Verlag. Reprinted with permission of Springer Science+Business Media.

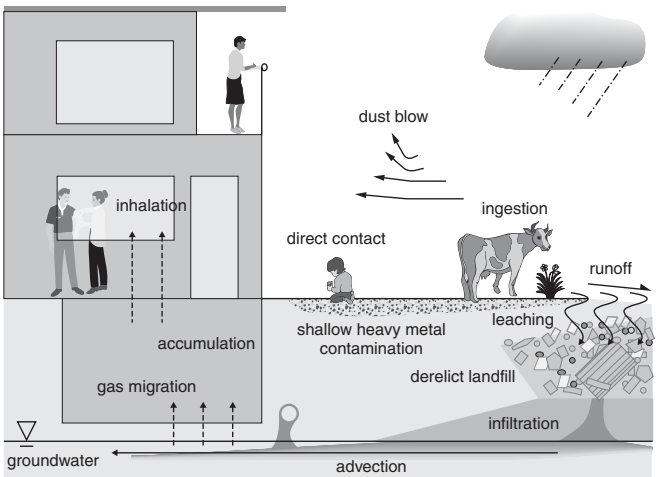


FIGURE 10.22 Contamination paths for solid wastes. *Source:* Genske, Dieter D.D. 2003. URBAN LAND: DEGRADATION, INVESTIGATION, REMEDIATION. Berlin, Germany: Springer-Verlag. Reprinted with permission of Springer Science+Business Media.

recycling process starts at the home site, where the wastes are separated by type. Then the different types are transported to the recycling center. Here each type is converted into a usable product. Energy savings from using recycled versus new products can be huge—often 75 percent or more. For aluminum cans, the savings is more than 90 percent (Marsh & Grossa, 2004).

Solid wastes cause controversy in cities. They produce odors and pollution and reduce land values. They might have health detriments, such as spread of infectious disease and susceptibility to cancer, and psychological impacts, due to fear and anxiety about their presence. In greater Delhi, India, solid wastes are shown discarded at the side of a highway (see Figure 10.23). They often lead to political disputes stemming from NIMBYism ("not in my backyard").

Love Canal, a 15-acre housing development located in Niagara Falls, New York, illustrates a toxic-waste contamination issue. Starting in the 1970s, residents noticed odors and chemicals leaking into houses, as well as a high incidence of disease symptoms such as birth defects, cancer, kidney

FIGURE 10.23 Solid wastes discarded at roadside, Greater Delhi. Photo by James Pick.

defects, rare cancers, and skin disorders (Blum, 2008; SUNY Buffalo, 1998). Although there were many complaints to the local government, there was no response. The contamination contributed to local economic problems, as well as impacting the residents and the adjacent ecosystems. Finally, links were discovered between the residents' problems and industrial contamination of the water, air, and soil. It was discovered that the former solid-waste landfill on which the Love Canal development was located had earlier received 20,000 tons of toxic chemicals, mainly from the Hooker Chemical Company. Love Canal was eventually designated as a federal disaster area in 1978, and residents were ordered by President Jimmy Carter to evacuate (Blum, 2008; SUNY Buffalo, 1998). In all, 239 families were relocated (SUNY Buffalo, 1998).

After 1978, the site underwent many years of cleanup, at a total government repair cost now estimated at $250 million (Marsh & Grossa, 2004). By 1998, although the toxic area was covered with a plastic liner and declared permanently off limits, the rest of the neighborhood was renamed Black Creek Village and made available for new settlement (CNN, 1998). Nearly all of the 239 homes were renovated and sold. The newly habitable area passed federal tests and was resettled (CNN, 1998). Although some poor and primarily Black renters in nearby communities were largely ignored in the cleanup, the outcome for Love Canal itself was mostly positive (Blum, 2008). In summary, this case demonstrates the severe impacts of a toxic-waste problem on a community, but also shows that focused and costly government action can result in remediation.

10.7 ENERGY

The modern city relies on energy to heat, cool, and light residential and commercial buildings; pump water; run all types of commercial and industrial equipment; provide transportation; and operate public services. This dependence can be seen dramatically during electrical crises, when cities grind to a near standstill. This happened during the New York blackout in July 1977 and again in the northeastern and Great Lakes states, as well as Canada, in the summer of 2003.

Energy has a geographical aspect, in that it is produced in particular locations and transferred to other locations for consumption. Its wastes and impacts are felt in particular geographical areas. Energy accounts for most of the globe's greenhouse gases, contributes to air pollution, and consumes land (Holdren, 2008). A GIS is a useful tool for analyzing urban energy flows and their impacts.

The world is consuming energy in ever larger quantities. For instance, between 1980 and 2006, worldwide primary energy demand grew by 62 percent (International Energy Agency, 2008). It is projected to expand by another 45 percent between 2006 and 2030 (International Energy Agency, 2008). The dominant energy forms are oil, coal, natural gas, biomass, nuclear, hydro, and renewables. A plot of past and projected world primary energy demand from 1980 to 2030 reveals that the use of all forms of energy has grown and will continue to do so. The largest projected yearly growth rates are for renewables (7.2%), coal (2%), hydro (1.9%), and natural gas (1.8%), while nuclear (0.9%) is the slowest growing (see Figure 10.24). The continued worldwide growth in demand for energy produced by coal, oil, and natural gas, all greenhouse gas sources, portends increasing movement in the United States and other advanced nations toward development of renewable energy sources (Martinot, 2006). However, coal, oil, and natural gas are projected to account for four-fifths of global energy demand in 2030, so high reliance will continue on producer nations rich in fossil fuels. Overall, by 2030, the world's energy demand is forecast to be 2.4 times that of 1980, growing at an annual rate of increase of 1.7 percent, which is slightly more than the rate of population

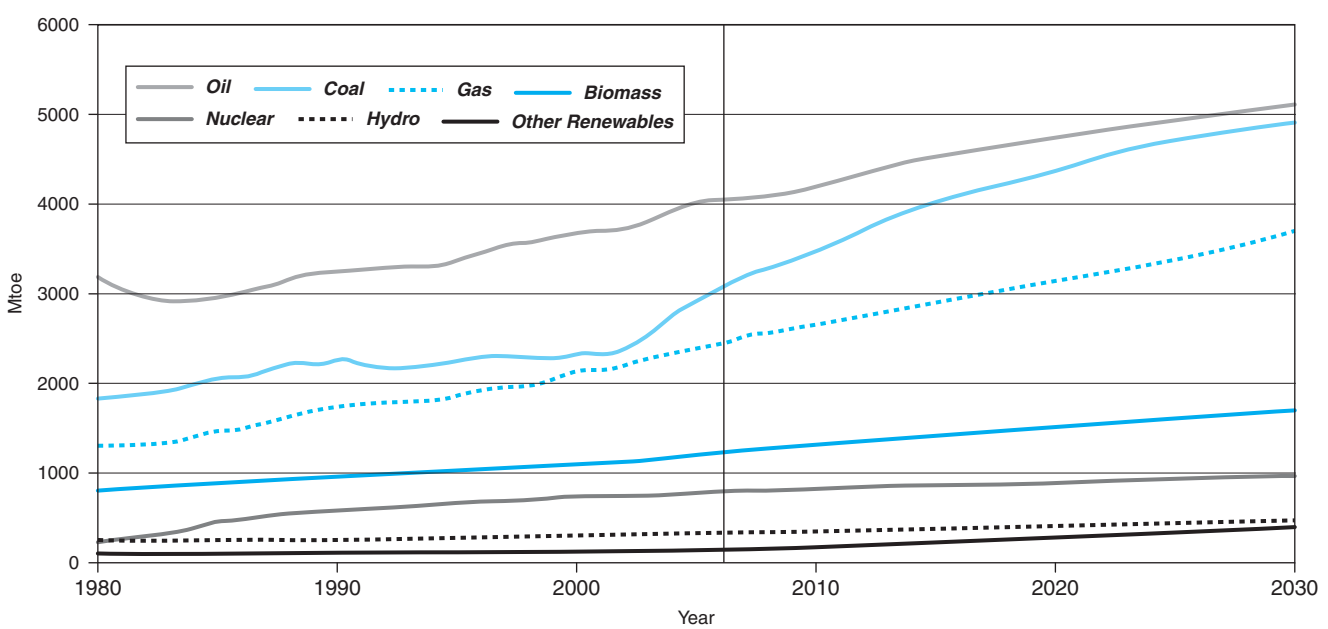


FIGURE 10.24 World primary energy demand by fuel, 1980–2030. (Mtoe = million tons of oil equivalent.) *Source:* International Energy Agency. World Energy Outlook 2008. Paris, France: Organization for Economic Co-operation and Development (OECD) and International Energy Agency (IEA). © OEDC/IEA. Reprinted by permission. Figure 10.24. P. 80.

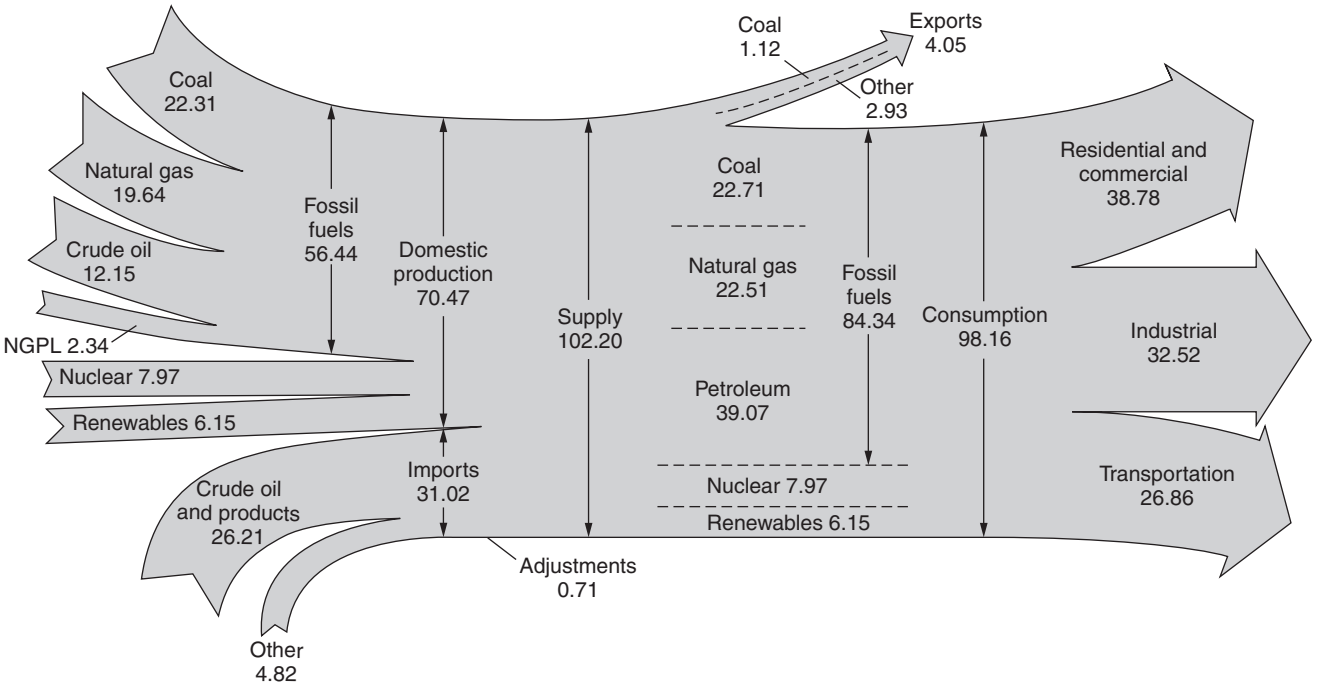


FIGURE 10.25 U.S. energy flow in 2003: Supply and consumption. *Source:* From Hinrichs/Kleinbach. ENERGY, 4E. © 2006 Brooks/Cole, a part of Cengage Learning, Inc. Reproduced by permission. www.cengage.com/permissions.

growth (International Energy Agency, 2008; Population Reference Bureau, 2008).

A model of energy supply and consumption for the United States, shown in Figure 10.25, portrays energy flows in 2003 (Hinrichs & Merlin, 2006, with data from U.S. Energy Information Administration). It is expressed in terms of *Quads,* which are quadrillions of British thermal units (BTUs). A *BTU* is the energy needed to increase the temperature of 1 pound of water by 1 degree Fahrenheit. In 2003, the United States was supplied with 102.20 Quads and consumed 98.16 Quads (U.S. Energy Information Administration, 2009). The extra energy of 4.04 Quads was exported to other nations, mostly as coal. The high dependency of the United States on imported energy is seen by the import of 31.02 Quads, or 30 percent of supply. This is especially high for crude oil, two-thirds of which is imported, mostly from Venezuela, Mexico, Nigeria, and the Middle East. Consumption is dominated by fossil fuels (86 percent), followed by nuclear energy (8 percent) and renewable energy (6 percent).

This consumption picture is similar to the world data in Figure 10.24, except that for the United States, the proportion of nuclear power consumption is lower. That difference exists because the nuclear energy program in the United States has been stalled for the past two decades, while it has continued to grow and even dominate in some other nations, such as France.

For the United States, the end uses of energy are evenly split among industrial (33 percent), residential and commercial (39 percent), and transport (27 percent). About half of the transport sector use of energy is due to automobile transport.

Energy in cities can be consumed as heat, electricity, or combustion. The electricity portion of overall energy has been rising more quickly than the heat portion because modern consumer and industrial products and appliances utilize more and more electricity. This includes use for information systems, air conditioning, refrigerators, dryers, and electric motors (Marsh & Grossa, 2004).

The major forms of energy have quite different origins, supply sources, and operation.

10.7.1 Fossil Fuels

Fossil fuels are based on energy that arrived on the earth from the sun tens of millions of years ago and was photosynthesized to form plants. Plants decompose over time and under certain conditions are deposited in the earth in gaseous, liquid, and solid states. This form of energy is mostly transported or piped, often over long distances, from extraction sites to power plants, where it is converted to electricity or heat. Oil and especially natural gas are less environmentally polluting than coal, so their use is growing more rapidly than that of coal. However, all fossil fuels do cause air pollution, the heating of water, and the release of greenhouse gases, including large amounts of CO_2, into the atmosphere; they also present environmental risks of leakage, explosions, and spills, as seen in the box "Energy Risk to Cities: Gulf of Mexico Oil Spill of April 20, 2010."

10.7.2 Nuclear

Nuclear energy depends on uranium, often obtained from other countries. Nuclear power plants are very large and expensive. Their energy production capacities are often 2,000 to

Energy Risk to Cities: Gulf of Mexico Oil Spill of April 20, 2010

At 10 P.M. on April 20, 2010, in the Gulf of Mexico, on the sea floor 5,000 feet underneath a British Petroleum (BP) offshore oil platform named Deepwater Horizon, the base of the well gave in to enormous pressure, cracked, and blew out, so that a huge volume of oil and natural gas burst up the mile-long well. As the natural gas moved upward and expanded, it ignited in a huge fireball that destroyed the platform, killing 11 petroleum rig workers and seriously injuring another 6 who survived. Although initially BP indicated 5,000 barrels of oil were being released daily into the Gulf of Mexico, many world experts estimated 30,000–60,000 barrels exuded out daily ("Tracking the Oil Spill," 2010). A barrel contains 42 U.S. gallons, so the release was 1.26–2.52 million gallons daily.

The U.S. government took measures to contain the spill, included spreading detergents on the surface of the water. Meanwhile, BP skimmed oil, burned some of it on the surface, and made a number of futile attempts to reduce or plug the flow, including trying to put a container dome on top of the broken wellhead. However, the sea-floor leak continued to spew oil largely unabated over the next several months, resulting in an accidental oil spill of over 205.8 million gallons of oil—the world's largest ever near a major urban area (Robertson and Krauss, 2010). After intervention by the federal government, BP capped and completely sealed the well on July 15, and it completed drilling relief wells on September 19, 2010, which finally terminated the crisis. By comparison, the 1969 Santa Barbara, California, oil well leak 5.5 miles offshore released only 4.2 million gallons of oil and was capped in 12 days, although it caused huge losses of marine life and seashore near the city. The 1989 grounding of the mega-tanker *Exxon Valdez* in Alaska released 10.8 million gallons of oil.

The urban effects from the BP oil spill are not yet known, but the threats involve Louisiana fishing industry losses and damage to species and ecosystems on a series of islands and coastal wetlands off the Louisiana coast (Kerr et al., 2010). The latter are already ecologically threatened and with long-term oil exposure could be seriously damaged. Their loss in turn would lower the coastal cities' barriers against hurricanes. Of great concern is the fact that their loss would increase the future risk for New Orleans, which was seen in Chapter 1 to have been partially destroyed from Hurricane Katrina.

The extent of the oil spill is seen in the NASA photograph taken by Japanese astronaut Soichi Noguchi on May 4, 2010, from the international space station (Figure 10.26). Because of reflected sunlight, water surfaces appear whitish, including the Gulf of Mexico and Lake Pontchartrain, in the upper right, which adjoins New Orleans. The Mississippi River is seen winding its way from the top right toward the center left, traveling through the Delta to empty into the Gulf of Mexico. The huge grayish oil spill is seen in the left and central lower half of the photograph. The image shows surface oil impact only 2 weeks after the spill, whereas the full effects will stretch over many years. Gulf and ocean currents have carried some environmental damages to western Florida—and damages could potentially extend around the tip of Florida.

On May 18, 2010, the National Oceanic and Atmospheric Administration (NOAA) closed the fisheries in the Gulf of Mexico over an area of 118,000 km^2 between the oil leak and Louisiana's offshore islands and coastal wetlands, which includes some of the richest shellfish zones in the country. This industry is crucial to the regional economy of the state's coastal cities, including New Orleans. It is a further blow to a devastated city that had somewhat revived its tourism and slowly regained portions of its former population.

Besides the environmental and economic impacts, legal claims of negligence will play out for years, and as with other spills and urban calamities, government will respond with new laws, regulations, and restrictions, many influencing cities. This disaster is one of many examples of the risks of fossil fuel as a form of energy to cities.

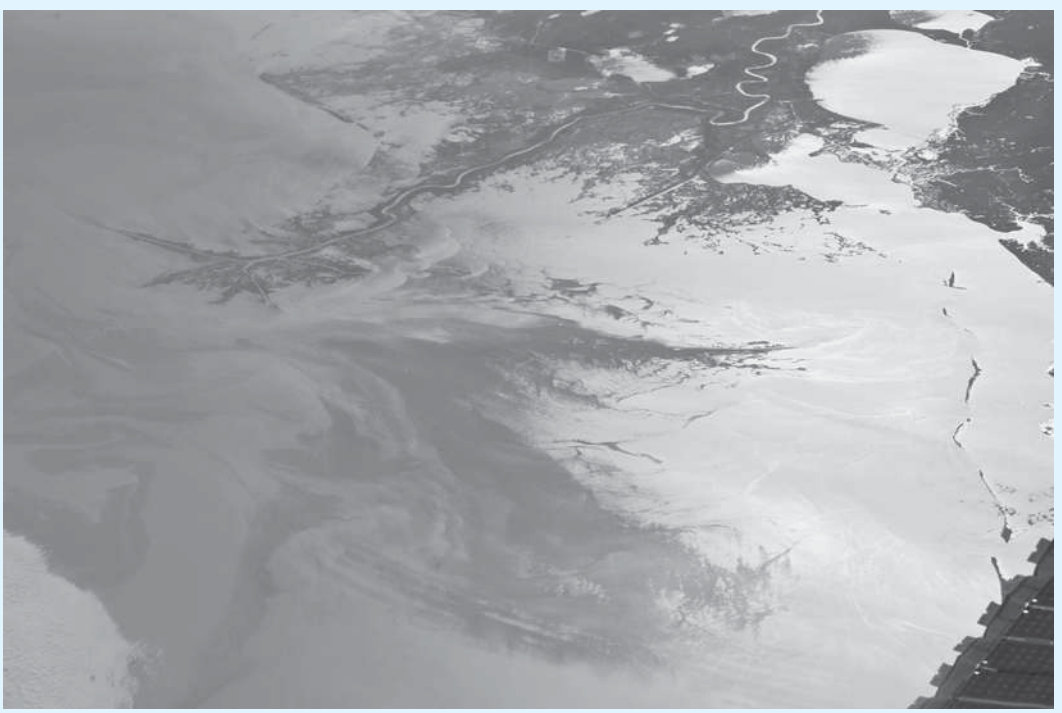


FIGURE 10.26 Oil spill, Gulf of Mexico, May 4, 2010. *Source:* NASA, International Space Station Science.

4,000 megawatts, about two to five times the output of a fossil fuel plant. A nuclear energy plant located in an urban area is seen in Figure 10.27. Nuclear technology is restricted by security provisions in some parts of the world due to concerns about nuclear proliferation and, worse yet, nuclear terrorism. It has the low, but ever-present, potential for causing severe environmental damage, with the worst instance having been the Chernobyl disaster in the Ukraine, causing tens of thousands of persons to suffer serious health problems, not to mention damage to biota (Macfarlane, 2010). Nuclear energy is concentrated in the United States, France, Japan, and South Korea (Goldenberg, 2007).

A major problem associated with nuclear energy is waste disposal. In the United States today, wastes are largely kept at

FIGURE 10.27 Nuclear energy plant in an urban area. *Source:* Color-Pic Inc.

nuclear sites, awaiting the opening of a permanent federal underground nuclear disposal site. The proposal for the permanent Yucca Mountain waste disposal site in Nevada has been controversial for years. The site is 100 miles northwest of the Las Vegas metropolitan area. It was removed from consideration by Steven Chu, Secretary of Energy in the Obama administration, who cut most of its budget (Wald, 2009), only to be reinstated in 2010 by judges at the U.S. Nuclear Regulatory Commission, who ruled that the Energy Department could not withdraw its Yucca Mountain site application (Wald, 2010). Its future is uncertain. Hence, for the mid-term future, waste is stored in many temporary industrial and military sites throughout the country. Worldwide, permanent sites have not been established, so more than 70,000 tons of accumulated nuclear waste are provisionally stored (Goldemberg, 2007). On the positive side, nuclear energy plants have low environmental impacts in their day-to-day operations, with cooling-water consumption being their major impact. They directly produce no atmospheric wastes, including greenhouse gases, from inside the nuclear plant. They do produce CO_2 and other greenhouse gases indirectly in the uranium mining, milling, and fuel production steps and during plant construction and transportation of materials (Mcfarlane, 2010).

10.7.3 Renewable Energy

Renewables include biomass, hydro, solar, geothermal, wind, and tidal energy. As seen in Table 10.6, traditional biomass (i.e., plant materials and animal waste) is the largest renewable source, followed by modern biomass, such as corn-derived ethanol, and traditional hydro. Renewables, introduced to a greater extent in the 1970s, have been developed into feasible forms of energy and are among the most rapidly growing types. For instance, the solar photovoltaic energy supply grew annually by 40 percent from 2001 to 2005. Renewables were initially mostly utilized for small-scale energy needs in the developing world, but today have moved into the mainstream. Among the country leaders are Germany in solar photovoltaics, Denmark in wind, and Brazil in biofuels (Goldemberg, 2007; REN21, 2006).

TABLE 10.6 Distribution of Renewables in the World's Total Primary Energy Supply

Type of Renewable	Percentage of Energy Supply	Annual Growth Rate in World Energy Consumption, 2001–2005
Traditional biomass	8.48	NA
Traditional hydro, other	1.73	NA
New renewable	3.40	11.5
Modern biomass	1.91	2.5
Geothermal	0.23	13.0
Wind	0.32	30.0
Solar photovoltaic	0.53	40.0
Small hydro	0.41	7.0
TOTAL	13.61	

Sources: J. Goldemberg. (2007). "Energy Choices Toward a Sustainable Future." *Environment* 49(10):7–17; REN21. (2006). *Renewables Global Status Report 2006 Update.* Paris and Washington, DC: REN21 Secretariat and Worldwatch Institute.

Hydroelectric energy comes from the mechanical energy of water flow, which turns power plant turbines to generate electricity. Hydro requires the damming of rivers, which could severely damage the natural environment. Otherwise, its operations are minimally intrusive. However, hydro plants are often located far away from major urban centers, so energy must be gridded over long distances. This results in grid losses of electricity and land consumption for transmission corridors. For instance, Mexico City is mostly powered by hydro energy sent from plants located many hundreds of miles to its south in the Pacific Ocean state of Chiapas.

Solar energy comes in the form of both solar power plants and individual units attached to homes and buildings, which are utilized for heating. Solar power plants are low polluting, but have the adverse impact of consuming large land areas for solar collectors. Both forms are especially effective in zones that receive high solar radiation such as Arizona, southern California, and northern Mexico.

Geothermal energy consists of energy production from hot water, steam, and gases generated inside the earth, which are brought to the surface and utilized to generate power for heating or sometimes to provide hot water for direct use. Exploitable geothermal energy tends to occur along tectonic plate edges—for example, in Japan, the Philippines, and Indonesia and along the U.S. Pacific Coast (northern California and near the United States–Mexico border). Its energy plants need to be located near the energy sources because very hot water cools rapidly when transported. So far, geothermal is a minor source of energy worldwide. The plants and pipelines have technical problems because the water is often salty and corrosive. Geothermal's environmental impacts are not negligible and include noise, smell, thermal impacts on water, air pollution, and land consumption.

Wind energy is one of the environmentally soundest forms of energy and, although minor, has been growing rapidly. Wind energy is mostly applied in large wind farms, where the energy can be put on the energy grid, rather than in small settings (Goldemberg, 2007). A wind farm near Palm Springs, California, seen in Figure 10.28, provides electrical energy to southern California cities. It has the major disadvantages that wind sources are erratic and its facilities consume land and can have visual impacts.

Tidal energy is utilized in special regions such as Japan that have flat areas of ocean shelf with substantial movement of tides. It has low economies of scale, and its technology is expensive. It is a form of energy that is fixed to particular power plant locations, which are unlikely to be convenient for major urban areas.

Energy is essential for the functioning of modern cities and is tied intimately to the urban economy. Wherever energy

FIGURE 10.28 Wind farm near Palm Springs, California, providing energy to southern California cities.

sources are located, their impacts on humans and the environment need to be determined. This is especially true in or near cities, where substantial human populations could be affected. An example of energy-driven pollution is seen in Cleveland in Figure 10.29. Energy has not been studied by geographers as much as have some other environmental factors such as water and toxic substances, partly because geographically referenced energy data are hard to come by. However, because it influences manufacturing, transportation, commerce, information technology, housing, government, and people's daily lives, energy constitutes an important part of urban geography.

Cities are the major location for energy consumption. Two-thirds of global energy is consumed by cities (International Energy Agency, 2008), and this ratio is forecast to grow by 2030 to three-quarters. The increase is linked to the rapidly growing urbanization of the developing world, especially south of the equator. For the United States and China, the largest energy-consuming nations in 2030, energy will primarily be consumed in cities—87 and 83 percent, respectively. Energy sources serving cities will be mostly coal, fossil fuel, and nuclear (International Energy Agency, 2008). The challenges facing cities with growing energy needs include conserving consumption, reducing wastes and air pollution, and moving more to carbon-free renewables, while keeping energy

FIGURE 10.29 Cleveland smokestack.

affordable to the consumer. The energy and climate change policy challenges for cities are discussed at greater length in the final chapter.

10.8 AIR POLLUTION

Urban air pollution is closely related to energy, industry, and transportation. This section presents the major forms of air pollution; its prevalence, dispersion, and transport; its impacts; and strategies to prevent and control it, including monitoring.

Air pollution derives from energy production of different types for vehicular transport, industry, lighting, heating, and domestic uses. It is linked, as are other environmental hazards, to expanding population.

The major categories of air pollutants are the following:

- *Sulfur dioxide and nitrogen oxides (SO_2 and NO and NO_2, often called NO_x).* They are released through combustion of fossil fuels in stationary sources. In developing countries, they are emitted through the burning of firewood and coal. Nitrogen oxides are also released from automobiles and other vehicles.
- *Carbon monoxide (CO).* It is released primarily from motor vehicle engines.
- *Ozone (O_3).* It is a photochemical oxidant. This means that it is formed from chemical oxidation reactions that involve nitrogen oxides and volatile organic compounds, which are emitted from transport, industry, and energy distribution. Ozone is most prevalent in hot, smoggy climates that are full of traffic such as Los Angeles.
- *Suspended particulates.* They include both natural particulates emitted from the soil and ecological processes and man-made particulates from motor vehicles, industry, rubbish, and energy combustion.
- *Trace air pollutants.* They are toxic pollutants, beyond the standard ones, that are present in trace amounts. Examples are carbon tetrachloride, benzene, formaldehyde, and methyl chloride (Miller, 2003). Hard to measure because of their slight concentrations, they can be carcinogenic and damaging to health.

Common pollutants in developed countries differ somewhat from those in developing ones. Advanced nations tend to have pollutants that stem from motor vehicles, especially nitrogen oxide, carbon monoxide, ozone, and particulates, whereas developing nations have a wider range of sources that include more particulates. Within developing countries, the mix might vary; for instance, Latin America tends to have more vehicle-based pollutants, while Africa has very few.

The concentration levels of the six major air pollutants are shown for the United States in 1999 in Figure 10.30. They include carbon monoxide, nitrogen dioxide, ozone, particulate matter, sulfur dioxide, and lead (Environmental Defense, 2004; U.S. EPA, 2004). This chart shows the areas of the country that have reached attainment of EPA standards for the six criteria air pollutants (light), counties for which part of the county is in nonattainment of standards (medium shade), and counties entirely in nonattainment (dark shade). It is clear that air pollution correlates with the location of major metropolitan areas. All of the nation's largest metropolitan areas are in nonattainment of EPA standards. The largest contiguous area of nonattainment is in and near the populous Boston-to-Washington corridor. The causes are its high concentration of vehicles, fossil power plants, and manufacturing industry. The second wide area of high nonattainment is in urban central and southern California. The elevated air pollution exposures of greater Los Angeles, Chicago, and Houston–Galveston are reflected in the 10 counties with the most person-days exceeding national ambient air quality standards (NAAQS) for six criteria air pollutants,

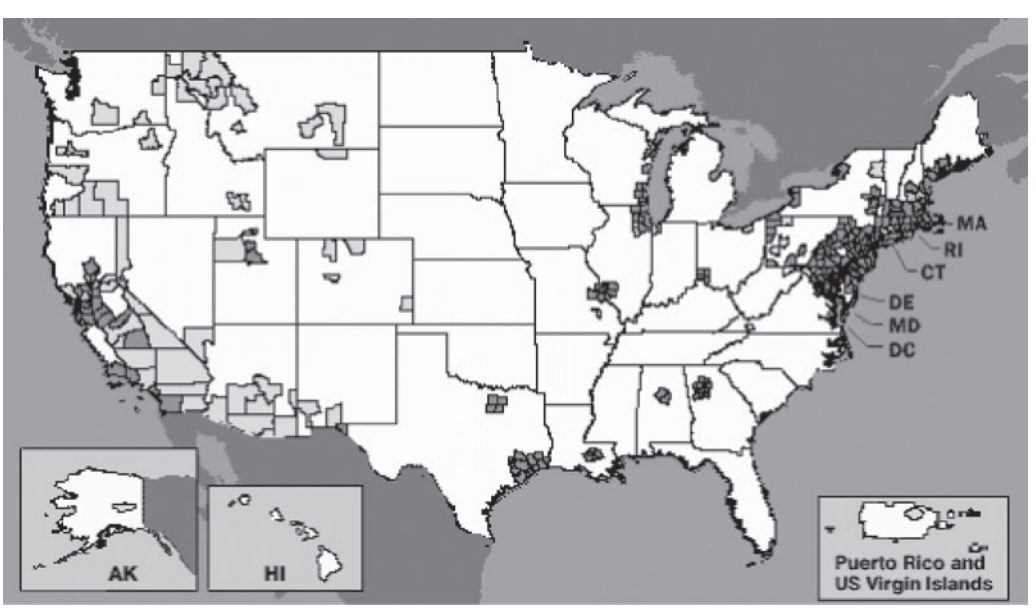


FIGURE 10.30 Concentration levels of the six most common air pollutants in the United States. (*Note:* The grey shadings are explained in the text.) *Source:* Environmental Defense. (2004). *Scorecard: The Pollution Information Site.* New York, NY: Author. Available at http//www.scorecard.org.

TABLE 10.7 Ten Counties with the Most Person-Days in Excess of National Ambient Air Quality Standards for Six Criteria Air Pollutants, 2002

Rank	County	Associated Major Urban Area	Person-Days in Excess of NAAQS
1	Los Angeles, CA	Los Angeles	2,588,936,328
2	San Bernardino, CA	San Bernardino	815,416,328
3	Cook, IL	Chicago	510,863,165
4	Harris, TX	Houston	508,658,865
5	Riverside, CA	Riverside	458,760,240
6	Fresno, CA	Fresno	322,167,952
7	Kern, CA	Bakersfield	266,518,656
8	Maricopa, AZ	Phoenix	194,928,684
9	Tarrant, TX	Fort Worth	140,517,672
10	Sacramento, CA	Sacramento	114,847,216

Note: The criteria air pollutants are carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide.

Sources: Environmental Defense. (2004). *Scorecard: The Pollution Information Site*. New York: Author. Available at http://www.scorecard.org; U.S. EPA. (2002). *Solid Waste Management: A Local Challenge with Global Impacts* (EPA 530-F-02-206d). Washington, DC: Author.

TABLE 10.8 Air Pollution Impacts

The health impacts are from direct inhalation and also from indirect routes, including contaminated drinking water, contaminated food, and transfer from skin. Impacts are common on respiratory and cardiovascular systems.

EFFECTS ON HUMAN HEALTH

Pulmonary function is affected by higher sulphur dioxide and particulates, and also nitrogen dioxide and ozone.

Ozone causes irritation to eyes, nose, and throat.

CO_2 can displace oxygen in the blood. This can have heart and neurobiology effects.

Lead "inhibits hemoglobin synthesis in red blood cells in bone marrow, impairs liver and kidney function, and causes neurological damage." Younger and more elderly persons are more susceptible.

EFFECTS ON THE ENVIRONMENT

Acid deposition: "Sulphur and nitrogen oxides are the principal precursors of acidic deposition." Long-range transport of sulphur and nitrogen oxides and acidic products causes the acidification and adverse impact on aquatic and terrestrial ecosystems.

Forests: Sulphur dioxide, nitrogen dioxide, and ozone can cause crop loss and damage to forests. Sulphur dioxide can damage buildings and art works.

Sources: United Nations and World Health Organization. (1992). *Urban Air Pollution in Megacities of the World*. Cambridge, MA: Blackwell; Molina & Molina. (2004). "Megacities and atmospheric pollution. *Journal of the Air and Waste Management Association* 54:644–680.

seen in Table 10.7 (Environmental Defense, 2004; U.S. EPA, 2004). All told, more than 100 million Americans live in urban counties in nonattainment of federal air pollution standards (Environmental Defense, 2004; U.S. EPA, 2004).

Air pollution is dispersed, trapped, and transported through a combination of topographic, atmospheric, and climatic conditions. Hills and mountains can serve as barriers that trap pollutants. Mexico City, surrounded on three sides by mountains and volcanoes, is a dramatic example. In a situation of *thermal inversion,* present often in Los Angeles, the normal temperature gradient is reversed, so temperature rises with altitude. In this case, the pollutants become trapped near their sources, close to the ground, and do not disperse. In an *urban heat island,* heat emitted from the city rises up, and cold air comes in underneath to replace it, drawing in polluted air from the surrounding regions. On a large scale, *street canyons* can form along city streets bounded by high buildings. The canyons trap pollutants and prevent their escape, but air dispersion does take place due to wind and traffic (Mazzeo & Venegas, 2010). Not only do pollutants impact the immediate metropolitan area, but also, for large, very polluted cities, the pollutants can be transported as an air pollution plume over great distances and register effects hundreds of miles away.

The many health impacts of air pollution on humans and natural organisms are summarized in Table 10.8. It is evident that the damages can be insidious, especially for more vulnerable young and elderly people.

Cities, regions, states, and the federal government are trying to combat this damaging problem in a number of ways. They have set emissions standards that have been useful in benchmarking and monitoring. Many urban governments have set up air pollution monitoring networks. These are a series of measuring stations networked together that continually record pollution levels. Cities can regulate air pollution by banning industrial plants, restricting or banning vehicular emissions, and requiring scrubbers, exhaust equipment, and other cleaning equipment on plants and vehicles. Additionally, urban governments can require energy conservation, which reduces the root cause.

Over the past two decades, Los Angeles has been a success story in reducing pollution. The Los Angeles Air Pollution Control District was established in 1947 and was merged in 1967 into the South Coast Air Quality Management District (SCAQMD) which also included Orange, Riverside, and San Bernardino counties. Stringent vehicular and industry emission standards were put in place starting in the 1970s by SCAQMD. It made major progress in fighting sources of air pollution, including restricting petroleum refineries in Long Beach, a steel plant, and lead smelters located inland. Consequently, nitrogen oxides fell from 450 ppm in 1987 to 325 ppm in 2000, and carbon monoxide was lowered during this period from 1,800 ppm to 1,150 ppm. The progress in halving the peak ozone concentration from 1970 to 1996 is seen in Figure 10.31. This example demonstrates that a local government can get its act together and concertedly attack environmental problems. Los Angeles still has a long way to go, but the current situation would have been much worse without the mitigation achievements.

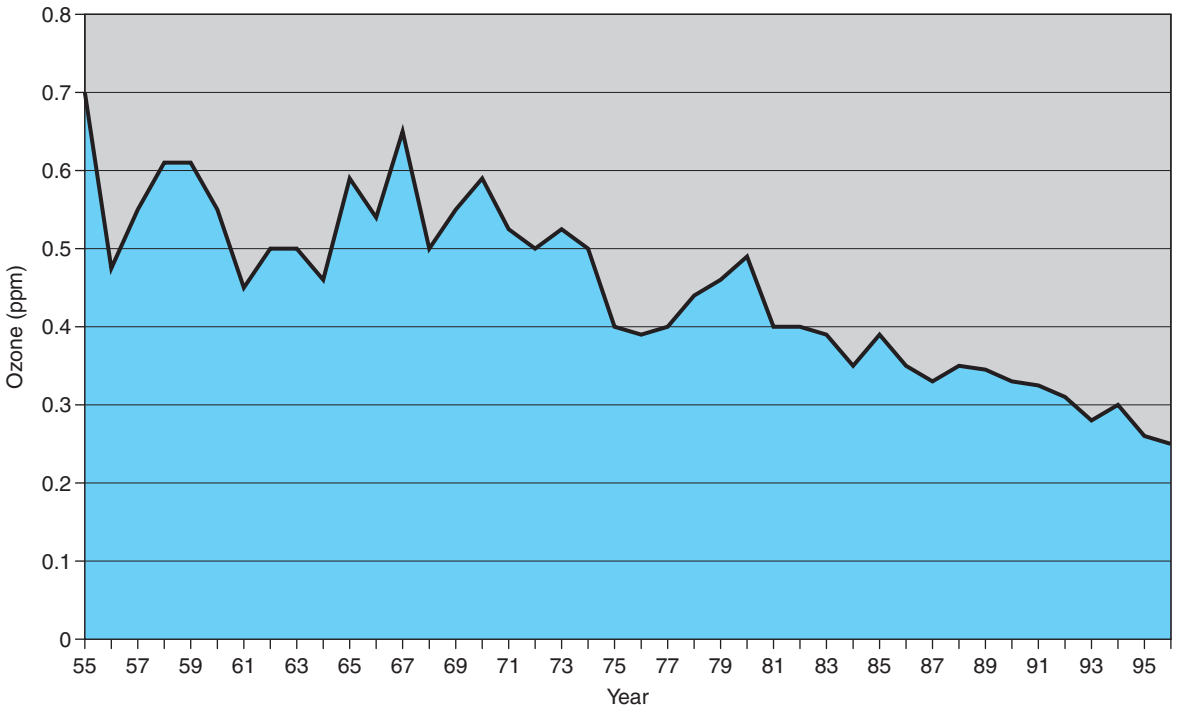


FIGURE 10.31 Peak ozone levels in Los Angeles, Orange, and parts of Riverside and San Bernardino Counties, 1955–1996. *Source:* South Coast Air Quality Management District, 1997.

10.9. ANALYZING AN URBAN ISSUE: ASTHMA IN CHICAGO

In June 2009, the EPA released the results of a national-scale assessment of air toxin emissions and found that millions of people are vulnerable to health risks due to living in neighborhoods where they are exposed to urban air pollution (U.S. EPA, 2009a). The EPA study relied on 2002 emissions data and focused on cancer risk, but it also considered respiratory problems and other health effects of air pollution. Others have looked at the risk of people suffering from asthma attacks due to exposure to air pollution. Oyana and River (2005) found that the age category most susceptible to asthma attacks induced by air pollution is children. Not only does air pollution cause attacks in asthmatic children, but also it makes children who don't have asthma more likely to develop it (California Air Resources Board, 2009).

So how does air pollution induce an asthma attack? Chemical reactions between nitrogen oxides (NO_x) and volatile organic compounds (VOCs) can create what is known as tropospheric or ground-level ozone, which is a respiratory toxicant that, when breathed in by humans, can create health problems, especially among asthmatics. Some of the major sources of NO_x and VOCs are industrial and electrical facility emissions, motor vehicle exhaust, gasoline vapors, and chemical sources. When these released pollutants chemically react with each other in the presence of heat and sunlight, ozone is formed. Breathing ozone not only triggers and worsens asthma conditions, but also aggravates other health problems such as chest pain, coughing, throat irritation, congestion, bronchitis, and emphysema.

In the Google Earth and ArcGIS exercise at the end of the chapter, we examine the relationship between air pollution and child asthma rates for Cook County, Illinois. Cook County has been a poor complier with ozone standards set by the EPA for several years, according to an evaluation of air standards done by the American Lung Association (2005). This is perhaps not surprising given Chicago's industrial history and its position as number three in population within the American urban system. Evidence for the relationship between asthma and air pollution can be seen by mapping the hospitalization rate per 10,000 resulting from ambulatory care for child asthma attacks in 2002 and overlaying the annual amount of toxic emissions by facility (Figure 10.32). There is a general correlation between the location of facilities that emit air pollutants and the location of the community areas that have the highest rate of emergency asthma cases among children. Indeed, if there is a causal relationship between air pollution and asthma in Chicago, then there might be an issue of environmental justice at play here, too, as some of the communities with the highest asthma rates are also some of the poorest communities in Chicago.

Nevertheless, there are some cautions that should be stressed in the interpretation of these map overlays. The first is that these are point source air pollution data, so wind can blow pollutants away from where they originate; for instance, urban ozone is notorious for traveling hundreds of miles from its origin. Season also affects the abundance of urban ozone, and since it forms in higher concentrations in the summer due to increased sunlight and heat, emergency pediatric hospitalizations brought on by asthma are more likely to be higher in the summer.

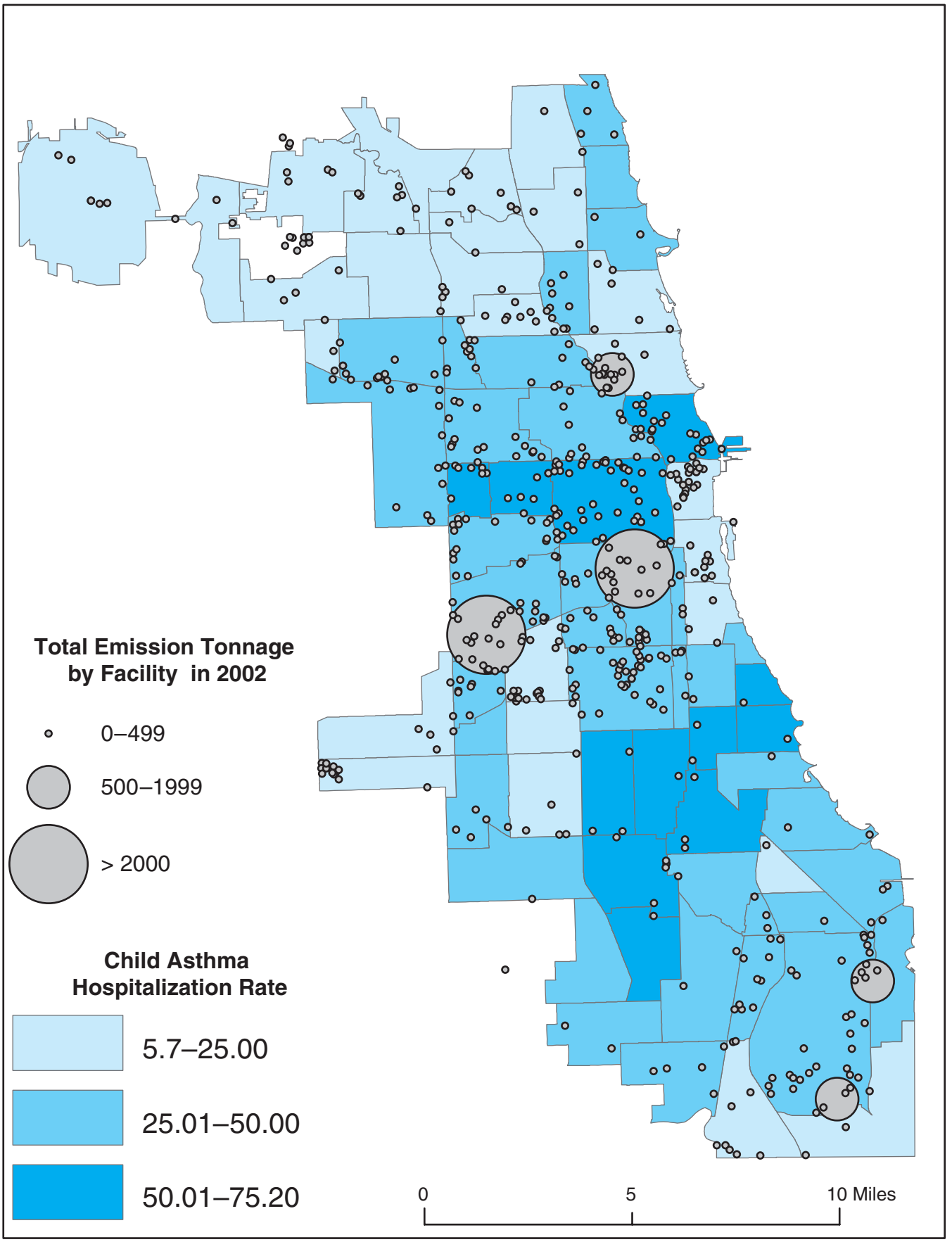


FIGURE 10.32 Pediatric asthma hospitalization rate and facilities emitting air pollutants in Chicago, 2002.

10.10 ENVIRONMENTAL JUSTICE AND PRESERVING THE NATURAL ENVIRONMENT

This part of the chapter looks at social and political responses to urban environmental problems. It introduces the concept of *environmental justice* and explains why it is important to cities. It also considers the environmental aspects of new paradigms in urban design, smart growth and new urbanism, that recognize many of the issues in this chapter. The full treatment of both environmental justice and the new paradigms takes place in the concluding chapter of this text, which presents a full case study that illustrates the planning and ethical complexity of the issues involved.

Environmental justice is defined as the fair treatment and significant involvement of all people, including those of different races, colors, national origins, and income levels, relative to the development, implementation, and enforcement of environmental projects, policies, and laws (modified from Bullard, 2000b, 2007). Many research studies have shown sharp inequalities in adverse environmental impacts, with weightings toward disadvantaged groups (Bullard, 2000a; Pulido, 2000). This has been shown fairly consistently in many areas of the United States and for a variety of environmental impacts. It was perhaps initially uncovered in the 1987 study of Los Angeles commissioned by the United Church of Christ (Bullard, 2000b). This careful statistical study confirmed that race was more highly associated with toxic waste sites than any other characteristic, such as land cost, property values, and income. Another pioneering environmental justice study was that of the U.S. government's Agency for Toxic Substances and Disease Registry (cited in Bullard, 2000b). The study concluded that lead poisoning disproportionately affected poverty-stricken, inner-city children. By ethnicity, it affected mostly Black population. This was exacerbated because Black children in the inner city were highly segregated. Following these studies, there have been many studies all over the country that have largely corroborated the associations of pollution and social deprivation.

Another example of environmental justice is a long-term dispute involving solid-waste disposal in New York City. The problem has been the huge amounts of solid waste generated by the megacity without adequate facilities to accept it (Gandy, 2002). Much disposal over the past 75 years has depended on the Fresh Kills Landfill located on Staten Island. It had become stacked up to a level of 500 feet—more than the giant pyramids of Egypt—which led to activism and protests by residents of Staten Island and finally to the city's commitment to its closure in 2001 (Gandy, 2002). This presented New York City planners with difficult choices. Among the alternatives historically considered were ocean dumping, recycling, alterative landfills, incineration, and export of wastes to distant communities for disposal. Ocean dumping was ruled out by court cases in the 1930s, and recycling on this scale has been too expensive (Gandy, 2002). There are no alternative landfills nearby, so the last two alternatives are the ones considered by the city.

Incineration was seriously pushed in the 1980s and early 1990s through efforts by the city to gain approval for huge incineration plants to be located in the former Brooklyn Navy Yard (Gandy, 2002). However, the major ethnic constituencies nearby in the Greenpoint–Williamsburg section of Brooklyn reacted with a solid wall of protest. The two major opposition groups were Latinos and Hassidic Jews. Although these communities had traditionally had very bad relations, the planned incinerators caused them to surprisingly unite on an issue. Protests through actions included a major united march of protest by Latinos and Hassidics across the Williamsburg Bridge in January 1993. In the end, these groups prevailed in overturning the city's plans. Currently, the city is looking to external communities to receive the waste at a cost. There have been efforts to increase recycling and to improve the worst areas. In 2010, New York City in partnership with other agencies commenced remediation of the Brookfield Avenue Landfill, one of the island's worst waste areas that had received toxic dumping in the 1970s, into a new park.

This case, which is fully described elsewhere (Gandy, 2002), underscores a number of environmental justice issues. There is the question of which communities are responsible for receiving environmental damages and at what cost. What are the responsibilities of urban entities to absorb their own waste and pollution within their own territory or trade waste disposal for money payments to other communities? How much detailed information should be gathered and provided to the general public of urban areas about environmental damages and trade-offs?

The body of work on environmental justice leads us to believe that the solutions to urban environmental problems might not rest solely with engineering and regulatory controls. There might be another dimension to environmental problems that involves the greater society and its inequities (Bullard, 2007; Bullard, 2000a, 2000b; Pulido, 2000).

The new paradigms of smart growth and new urbanism add another dimension to the solution of urban environmental problems. They call for a different kind of planning and development for cities than what took place in the second half of the 20th century. Among the elements are compact development; attention to the conservation of environmental zones and farmland; redevelopment of deteriorated central-city areas, such as some brownfields, through an approach called "infill"; mixed land uses, rather than sharply separated single land uses; and planning that includes transportation from the start. They are mentioned here because they include environmental sustenance and improvement as central goals. Rather than adopting a "master builder" approach that more concrete and higher buildings are better, they seek a more even balance between natural systems and human systems. These approaches, including a complex planning case study of Irvine Ranch in southern California, are explored in the final chapter.

Summary

This chapter examined urban environmental science and problem solving as a part of the urban system. It covered basic concepts and principles and then moved to the major types of environmental problems, including climate change, land use, water, flooding, fire, solid waste, energy, and air pollution. Each of these has complex relationships with the city, as well as policy and regulatory issues. The chapter focused somewhat more deeply on analyzing the geographical distribution of asthma in Chicago, the topic of this chapter's lab. Finally, the chapter turned to environmental justice and to the planning, social, and ethical aspects of the urban environment, issues that are explored more in the next chapter.

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Exercise

Exercise Description

Examining the relationship between child hospitalization rates for asthma and air pollution in Chicago's community areas.

Background Information

Air pollution in megacities has become a critical urban policy issue, especially as it relates to health. Chicago provides a good case study because it is located in Cook County, which is on the U.S. EPA's top 10 list of counties with the most person-days that exceed national ambient air quality standards.

Course Concepts Presented

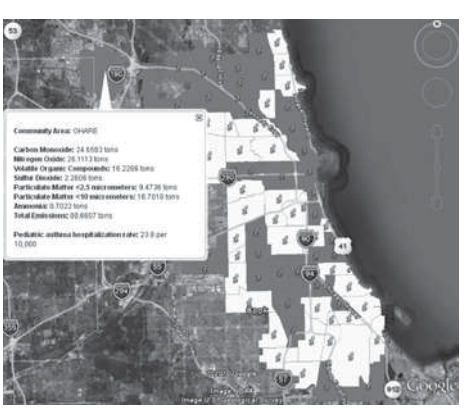
This exercise reinforces the concept of environmental justice and the overall relationship between environmental problems and urban health impacts.

Google Earth Version

1. Launch the Chapter 10 Google Earth KMZ file by double-clicking it:

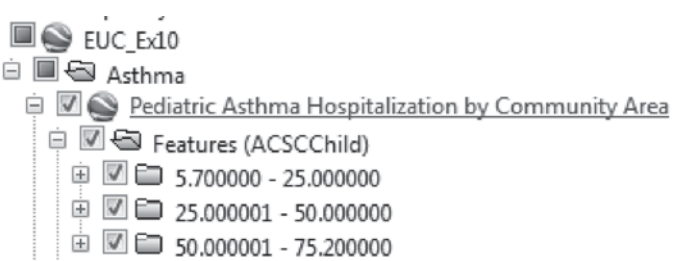
   EUC_Ex10.kmz

   Google Earth zooms in to Chicago and displays its community areas, which are color coded according to the child hospitalization rate for ambulatory care due to asthma attacks. Click "i" on any one of the 77 community areas, and you will display the 2002 pediatric asthma hospitalization rate for that community, as well as the tonnage of various air pollutants from selected facilities inside that community area. For instance, the community area of O'Hare, which mostly includes the international airport, but has some residential areas on the fringe, has a relatively low rate of child asthma (the overall rate for Chicago was 31.6), but relatively high amounts of air pollution emissions.



The asthma data represent the hospitalization rate per 10,000 population resulting from ambulatory care for child asthma attacks in 2002. The data are provided on each city community area in the form of "Health Profile" pages set up online by the Chicago Department of Public Health: http://www.cchsd.org/cahealthprof.html. For more background, visit the site, scroll down to Profiles by Community Area, and click the dropdown to select a community. The pediatric asthma rate can be found on page 5 of the health profile report.

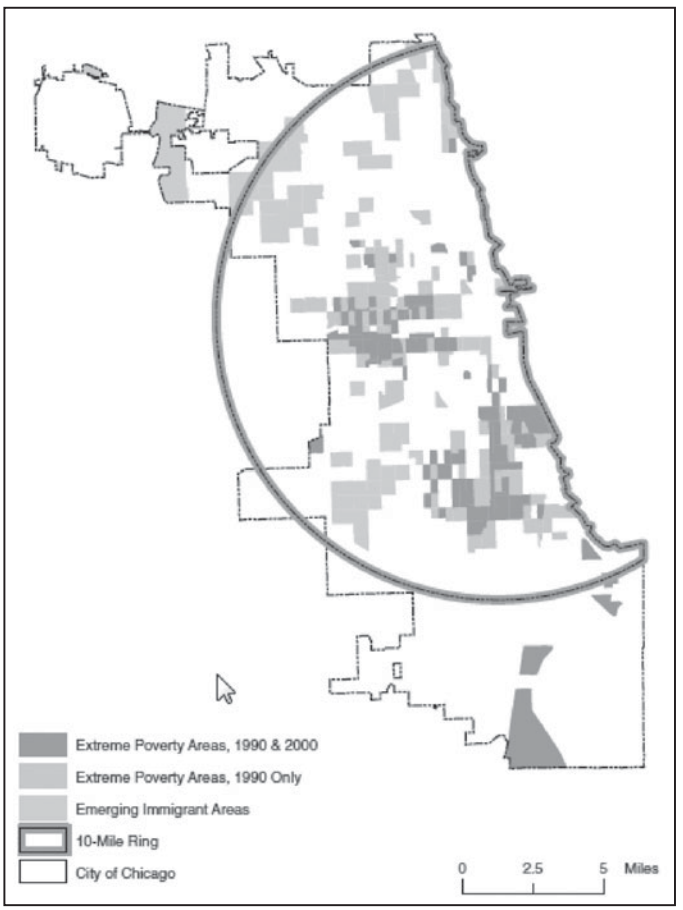
2. Expand EUC_EX10 in the Table of Contents of Google Earth. Also expand the Features item under Pediatric Asthma Hospitalization by Community Area, and note the three data ranges for the rates of hospitalization of children receiving ambulatory care for asthma in 2002.

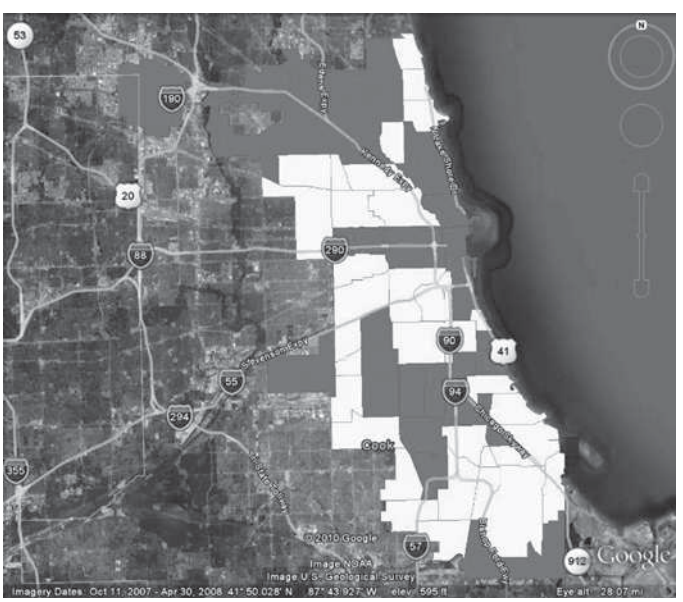


   Expand each of the ranges and click to see the color associated with each community area, and then collapse it to see only the numeric range; otherwise, it becomes unreadable.

3. What asthma rate does blue represent on the map?
   Light yellow?
   Red?

4. An earlier chapter section discussed the concept of environmental justice and mentioned spatial inequalities in environmental impacts, as well as in health outcomes. On page 344, on the left is a map of Chicago's poverty areas that was discussed in Chapter 3.





5. By examining these two maps, can you make an association between the community areas with the highest child asthma rates and the lowest incomes? Explain.
6. Collapse Pediatric Asthma Hospitalization by Community Area, and expand Features under High Total Emissions. Toggle on and off each of the ranges to see the size of the map symbol associated with selected air polluting facilities throughout Chicago. Click the large red circle just southeast of the city of Cicero to see emission information for the largest total emitter, a coal power plant in the Lawndale community area. You can locate the city of Cicero by searching for "Cicero, IL." Click the Ruler, and change its measurement unit to yards. How many yards is this power plant from the Stevenson Expressway?

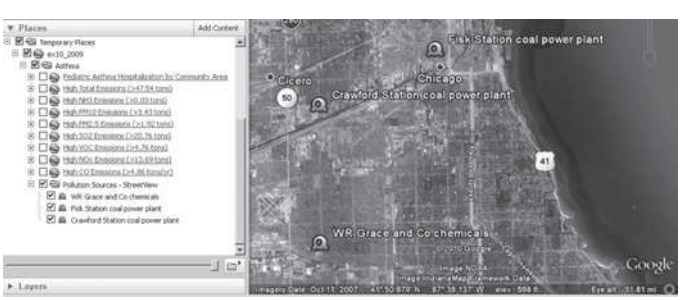
The emissions points include facilities selected from the 1,397 facilities that emitted particulates (<2.5 micrometers) in 2002. The data were acquired from the U.S. EPA's interactive "AirData" website: http://www.epa.gov/air/data/index.html. For more background, visit the site, and click Reports and Maps; select Cook County, Illinois from the Select Geographic Area option; click Facility Emissions under Maps; select PM2.5-Particulate—<2.5 micrometers—under the Pollutant Emitted dropdown; and click Generate Map. Once the map is generated, you can scroll to the bottom and view more emissions information for these selected facilities.

7. Experiment by toggling on and off the various types of emissions to look for spatial patterns in the facilities that emit air pollution. Compare them to the distribution of Pediatric Asthma Hospitalization.

Key

NH_3	Ammonia
PM 10	Particulates less than 10 micrometers
PM 2.5	Particulates less than 2.5 micrometers
SO_2	Sulfur dioxide
VOC	Volatile organic compound
NO_x	Nitrogen oxide (***x*** designates oxygen composition)
CO	Carbon monoxide

8. Collapse High Total Emissions and any other emission items you previously expanded. Expand the last item, Pollution Sources–StreetView, and we will use StreetView to see three preselected facilities that emit air pollution.



9. Turn off the Asthma layer, as it blocks the aerial view. Double-click "Crawford Station coal power plant" to zoom to it. Once

there, drag the yellow Street View icon onto the street near the point on the map.

10. Save several of the above street views and several of a different pollution source that you are able to find on your own as a jpg image to include with your essay.

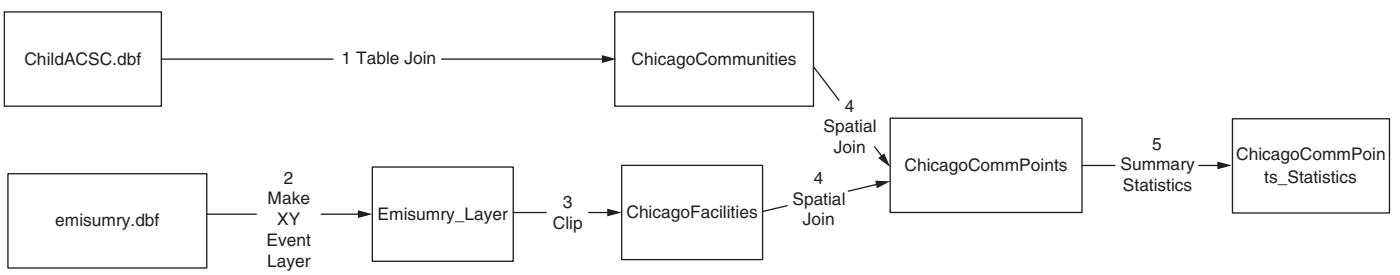
Compare the features of the two pollution sources you examined in step 10. Consider air pollution impacts on the immediate neighborhood of the sources, nearby transportation. Describe the two sources, and indicate any pollution mitigation potential you see.

Google Earth Short Essay: Next, compare each of the eight pollution source patterns with the areas having a low pediatric asthma hospitalization rate (5.7–25 per 10,000 population). Which pollution sources are not present, or have a very low presence, in the areas having a low pediatric asthma hospitalization rate?

On the other hand, ammonia emissions are fairly equally prevalent in the areas of low, medium, and high asthma hospitalization rates. Would you rule ammonia out as linked to asthma hospitalization or not? Justify your answer.

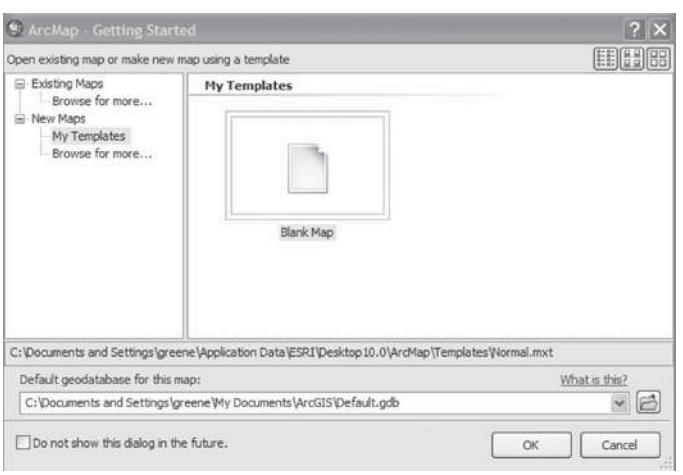
ArcGIS 10 Version

Exercise Procedure Flow Chart



Part 1: Join a Table of Child Ambulatory Rates to a Shapefile of Chicago's Community Areas

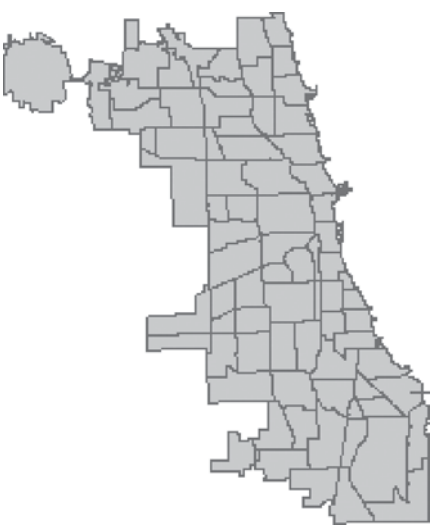
1. Start ArcMap. Under New Maps, click My Templates, and then double-click the Blank Map template.



2. Click Add Data, and navigate to the exercise data folder.

Note: If you do not see the folder where you placed the exercise data, you will need to make a new connection to the root directory that holds the data.

3. Add ChicagoCommunities from the Chapter 10 folder by selecting it and clicking Add.



The ChicagoCommunities shapefile originates from the city of Chicago's GIS Department:
http://www.cityofchicago.org/city/en/depts/doit/supp_info/gis_data.html
Scroll down to Boundary Data.

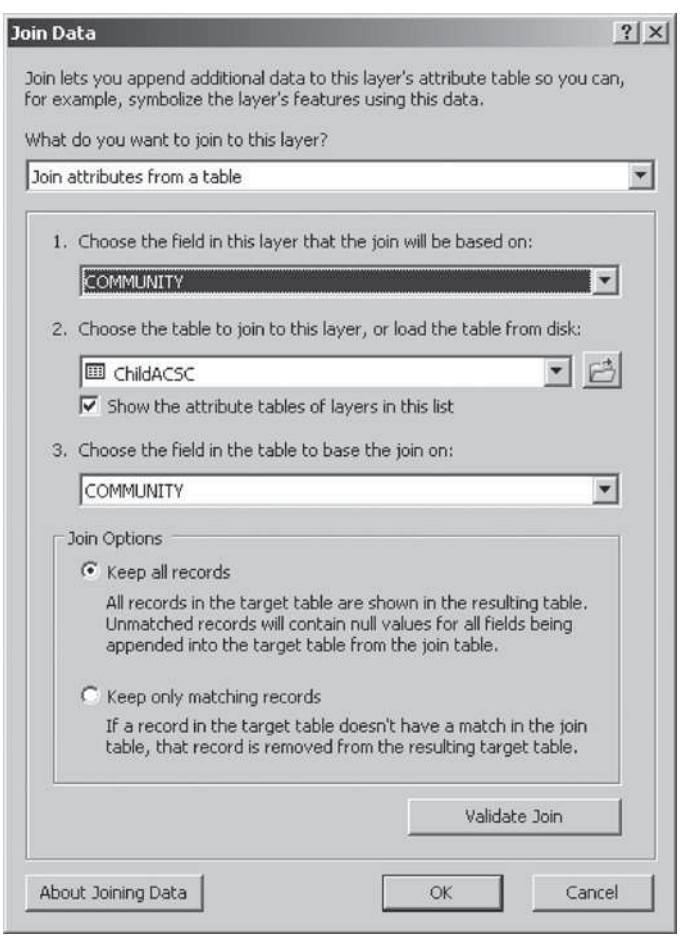
Community areas are aggregations of census tracts that were originally created by the University of Chicago in the late 1920s. Today, there are 77 such community areas, and they have changed very little since their inception. In addition to allowing for census block and tract aggregations, community areas have other data associated with them that have been compiled by the city and a number of local community organizations.

4. Click Add Data again, and add the ChildACSC.dbf table to the map.

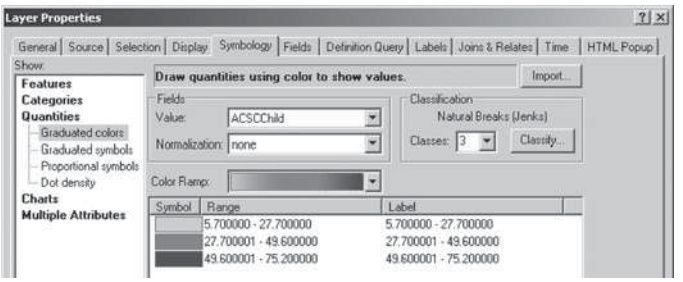
Community	ACSCChild
Rogers Park	42.4
West Ridge	17.5
Forest Glen	9.8
O'Hare	23.8
Norwood Park	5.7
Edgewater	29
North Park	14.3
Jefferson Park	9.6
Lincoln Square	12.6
Uptown	33.6

The ACSCChild field in the table represents the hospitalization rate per 10,000 population resulting from ambulatory care for child asthma attacks in 2002. The child asthma rate has already been extracted from all 77 health profile pages and entered into the table you added to the map.

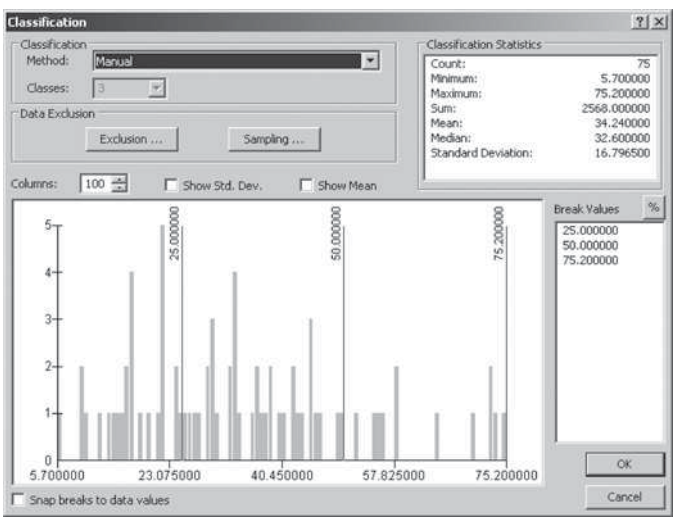
5. Right click ChicagoCommunities, and click Joins and Relates and then Join to join the ChildACSC.dbf table to the community areas by the community area name.


Join Data
Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data.
What do you want to join to this layer?
Join attributes from a table
1. Choose the field in this layer that the join will be based on:
COMMUNITY
2. Choose the table to join to this layer, or load the table from disk:
ChildACSC
Show the attribute tables of layers in this list
3. Choose the field in the table to base the join on:
COMMUNITY
Join Options
Keep all records
All records in the target table are shown in the resulting table. Unmatched records will contain null values for all fields being appended into the target table from the join table.
Keep only matching records
If a record in the target table doesn't have a match in the join table, that record is removed from the resulting target table.
Validate Join
About Joining Data
OK
Cancel

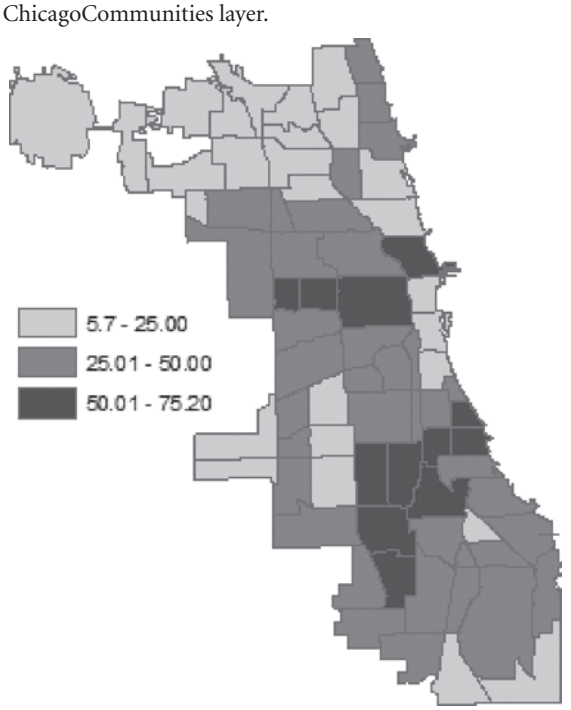
6. Right click ChicagoCommunities, click Properties, click the Symbology tab, click Quantities under Show, click Graduated Colors, select ACSCChild under Value in the Fields box, and change Classes to 3.



7. Click Classify on the Classification dialog box, and change the Break Values manually to the following:
   a. 25.000000
   b. 50.000000
   c. 75.200000

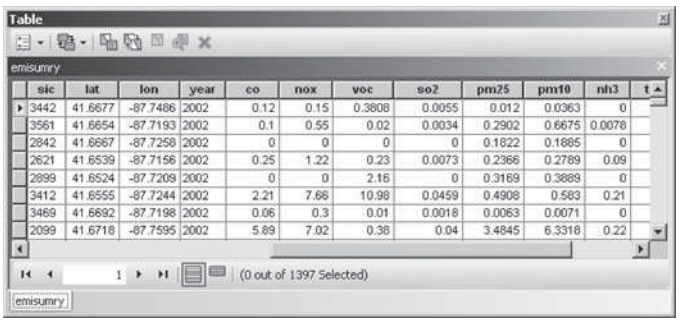


8. Click OK, Apply, and OK to see your classification applied to the ChicagoCommunities layer.



Part 2: Acquire and Map the Locations of Facilities That Emit Air Pollution

9. Click Add Data, and add the emisumry.dbf table to the map.

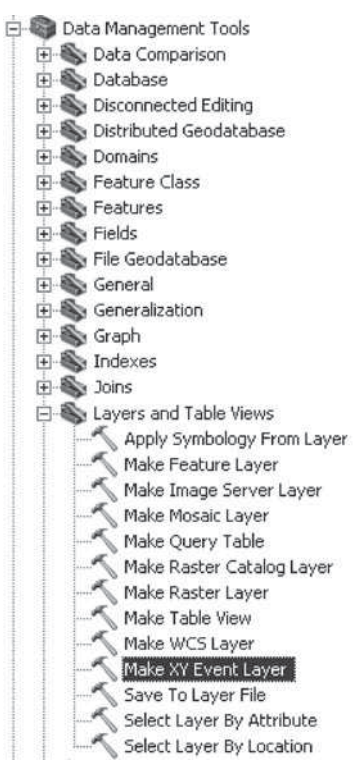


sic	lat	lon	year	co	nox	voc	so2	pm25	pm10	nh3	t
3442	41.6677	-87.7486	2002	0.12	0.15	0.3808	0.0055	0.012	0.0363	0	
3561	41.6654	-87.7193	2002	0.1	0.55	0.02	0.0034	0.2902	0.6675	0.0078	
2842	41.6867	-87.7258	2002	0	0	0	0	0.1822	0.1885	0	
2621	41.6539	-87.7156	2002	0.25	1.22	0.23	0.0073	0.2366	0.2789	0.09	
2899	41.6524	-87.7209	2002	0	0	2.16	0	0.3169	0.3889	0	
3412	41.6555	-87.7244	2002	2.21	7.66	10.98	0.0459	0.4908	0.583	0.21	
3469	41.6892	-87.7198	2002	0.06	0.3	0.01	0.0018	0.0063	0.0071	0	
2099	41.6716	-87.7595	2002	5.89	7.02	0.38	0.04	3.4845	6.3318	0.22	

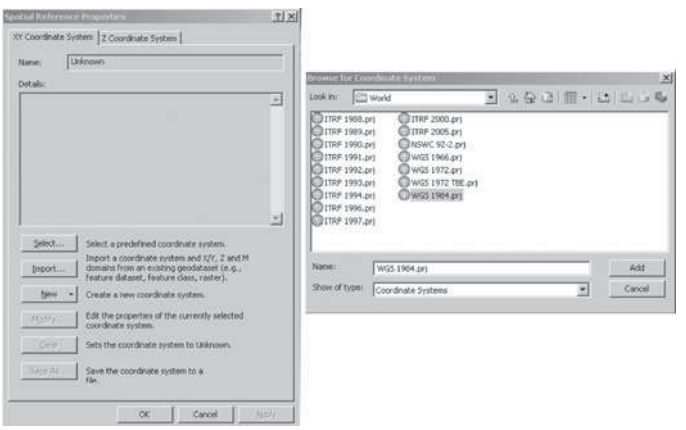
The emisumry.dbf table includes 1,397 facilities that emitted particulates (<2.5 micrometers) in 2002. The table was acquired from EPA's interactive "AirData" website: http://www.epa.gov/air/data/index.html (Click Reports and Maps; select Cook County, Illinois from the Select Geographic Area option; click Facility Emissions under Maps; select PM2.5-Particulate—<2.5 micrometers—under the Pollutant Emitted dropdown; and click Generate Map. Once the map is generated, you can scroll to the bottom and download all of the records as a dbase table.)

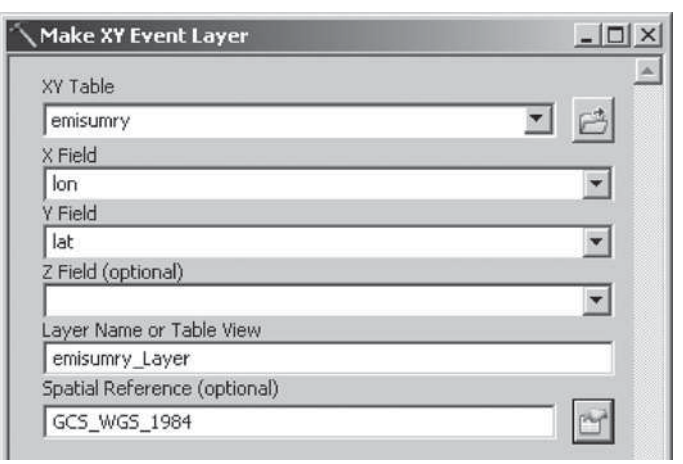
In addition to tons of particulates emitted in 2002, the table shows other air pollutants emitted plus the latitude and longitude of the facility. The latter two fields will allow us to generate points in our GIS so that we can analyze differences in pollutant magnitude across Chicago's community areas.

10. Open ArcToolbox. Choose Make XY Event Layer, which is located in Layers and Table Views under Data Management Tools.



11. Choose the emisumry table from the dropdown menu. The X Field and Y Field should automatically be filled with lon and lat, respectively. Click the button to set the Spatial Reference. In the Spatial Reference Properties window, click the Select button, and browse to Geographic Coordinate Systems and then to World. Choose the WGS 1984.prj file.

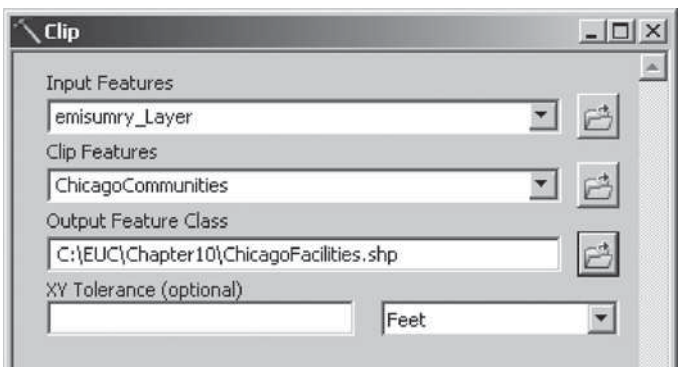




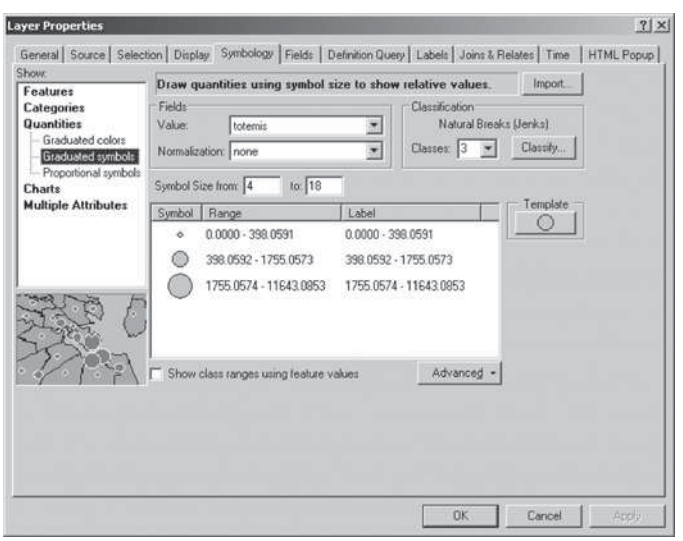
12. The Make XY Event Layer tool converts the table's longitude and latitude fields to points on the map in a temporary layer called an Events layer.

The facility Events layer extends beyond the City of Chicago, so we clip the points by the ChicagoCommunities layer. Click ArcToolbox, and select Analysis Tools, Extract, then Clip.

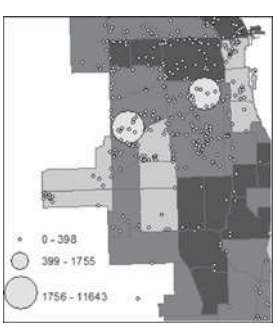
13. In the Clip window, choose emisumry_Layer as the Input Features and ChicagoCommunities as the Clip Features, and specify ChicagoFacilities.shp as the Output Feature Class. Click OK (ignore the datum warning if it appears).



14. Right click ChicagoFacilities, click Properties, click the Symbology tab, click Quantities under Show, click Graduated Symbols, select totemis under Value in the Fields box, and change Classes to 3.

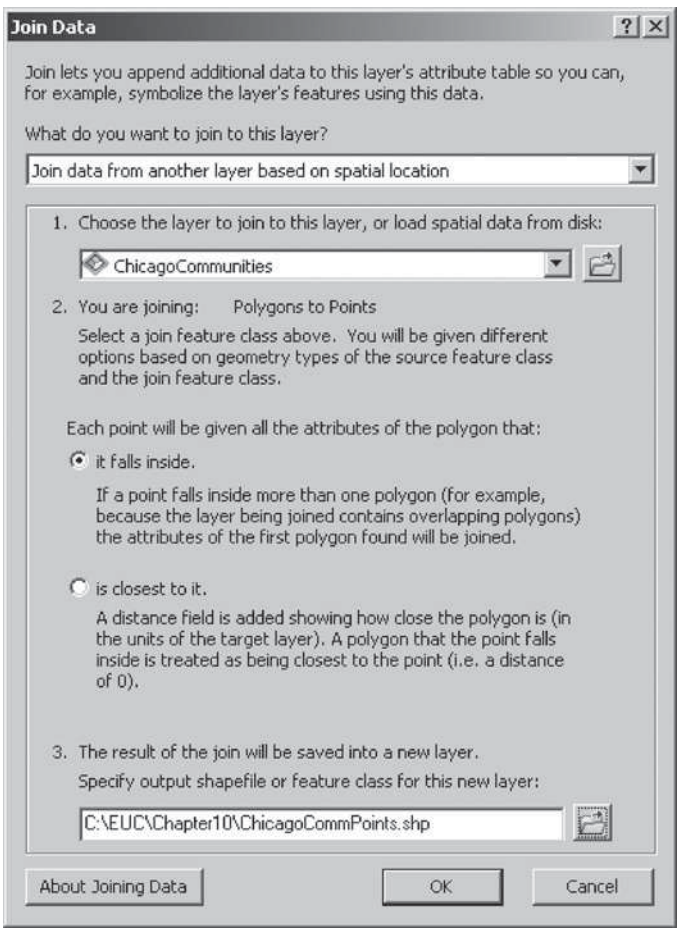


15. Click OK to see the results of your classification.



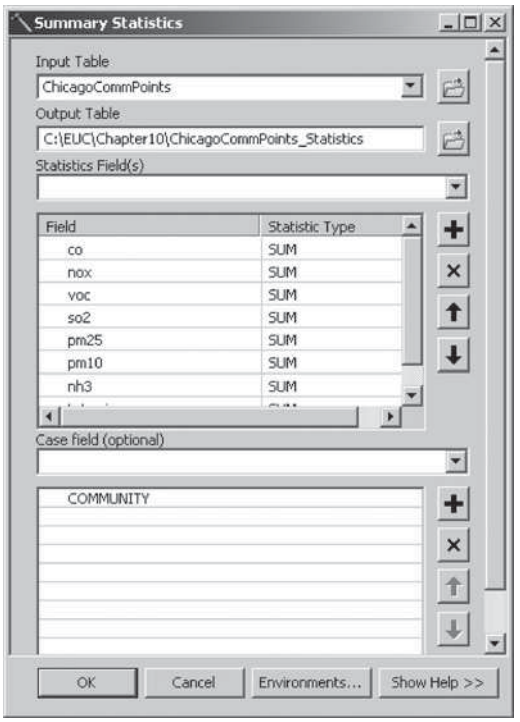
Part 3: A Challenge Step—Aggregate the Facilities Emissions Data by Community Area and Join the Summary Statistics to the Community Areas

16. Right-click the ChicagoFacilities layer, and click Joins and Relates and then Join. Change from a table join option to "Join data from another layer based on spatial location." Select ChicagoCommunities as the layer to join to this layer, and choose "it falls inside" for the attribute assignment. In number 3, call the new layer ChicagoCommPoints, and click OK.

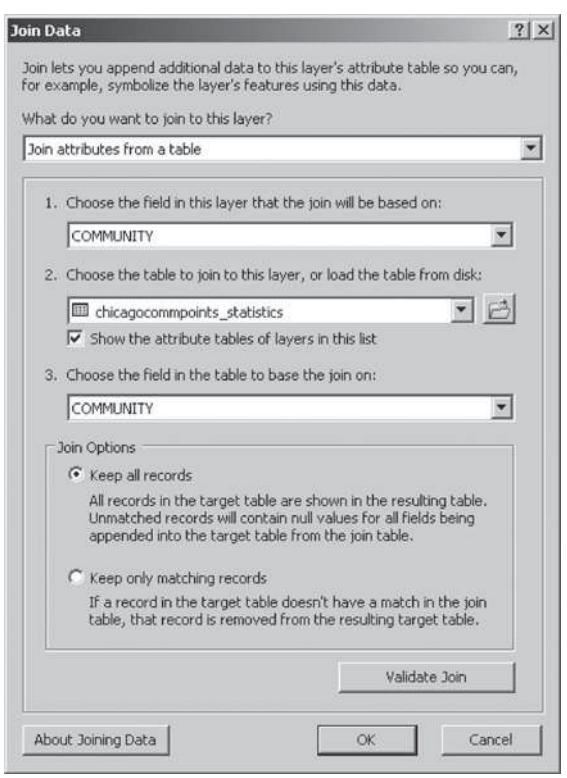

Join Data
Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data.
What do you want to join to this layer?
Join data from another layer based on spatial location
1. Choose the layer to join to this layer, or load spatial data from disk:
ChicagoCommunities
2. You are joining: Polygons to Points
Select a join feature class above. You will be given different options based on geometry types of the source feature class and the join feature class.
Each point will be given all the attributes of the polygon that:
it falls inside.
If a point falls inside more than one polygon (for example, because the layer being joined contains overlapping polygons) the attributes of the first polygon found will be joined.
is closest to it.
A distance field is added showing how close the polygon is (in the units of the target layer). A polygon that the point falls inside is treated as being closest to the point (i.e. a distance of 0).
3. The result of the join will be saved into a new layer.
Specify output shapefile or feature class for this new layer:
C:\EUC\Chapter10\ChicagoCommPoints.shp
About Joining Data
OK
Cancel

17. In ArcToolbox, click Analysis Tools and then Statistics, and double-click Summary Statistics.

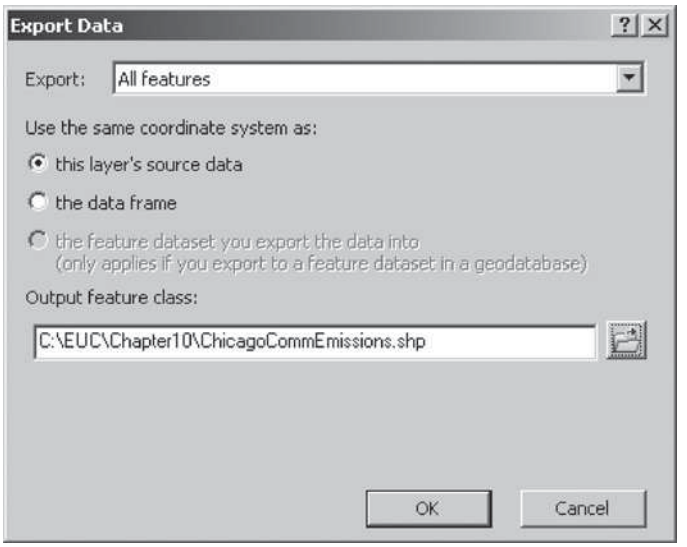
18. Choose ChicagoCommPoints for the Input Table, and browse to your project folder to create the Output Table. For statistics, choose each pollutant, and set SUM as the type of statistic. Most importantly, choose COMMUNITY for the Case field.



19. Click OK to sum the tons of pollutants by community area.
20. Join the new Statistics table to your ChicagoCommunities layer. Right-click ChicagoCommunities, and click Joins and Relates and then Join. Click "Join attributes from a table," select COMMUNITY (the first instance) as the join field, select chicagocommpoints_statistics as the table and COMMUNITY as the join field, and click OK.


Join Data
Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data.
What do you want to join to this layer?
Join attributes from a table
1. Choose the field in this layer that the join will be based on:
COMMUNITY
2. Choose the table to join to this layer, or load the table from disk:
chicagocommpoints_statistics
Show the attribute tables of layers in this list
3. Choose the field in the table to base the join on:
COMMUNITY
Join Options
Keep all records
All records in the target table are shown in the resulting table. Unmatched records will contain null values for all fields being appended into the target table from the join table.
Keep only matching records
If a record in the target table doesn't have a match in the join table, that record is removed from the resulting target table.
Validate Join
About Joining Data
OK
Cancel

21. Right-click the ChicagoCommunities layer, click Data and then Export Data, and call the new output layer ChicagoCommEmissions.



22. ChicagoCommEmissions has the asthma rate, a count of the number of facilities, and the total emissions from those facilities.
23. Make two maps side by side to show quantities of both child asthma rates and emissions.
24. A more ambitious analysis would be to compute a regression specifying the asthma rate as the dependent variable and total emissions as an independent variable to see the association of the two variables. See the Chapter 3 ArcGIS exercise for a review of these procedures.

ArcGIS Short Essay: In your essay, review the "Analyzing an Urban Issue: Asthma in Chicago" and other chapter sections on air pollution. Discuss the relationship between child asthma hospitalization rates and air pollution for Chicago's community areas. Discuss strengths and limitations of the data used to conduct the GIS analysis.

Log in to www.mygeoscienceplace.com for ArcGIS Exercise data files, Google Earth™ Exercise kmz files, RSS feeds, flashcards, web links, and self-study quizzes to enhance your study of environmental problems.

CHAPTER

11 Urban and Regional Planning

Cities have been planned since ancient times. Some cities centuries ago planned and implemented projects that stand out today. Contemporary planning confronts some of the same urban problems, as well as new ones, but can apply many modern methods, concepts, and technologies. Urban planning is one of the most important aspects of the study of cities. It is, after all, the way that design, order, integration, and redevelopment can occur. Many of the topics already covered bear on urban planning, including urban economic development, urban structure, population, neighborhoods, poverty zones, transportation, industrial location, urban sprawl, edge cities, environmental processes, and geographic information systems (GIS).

A geographical perspective to city and regional planning is essential. Geography informs planning on spatial proximities, flows, scale relationships, the arrangement of the natural environment, and many other aspects. This chapter is an appropriate capstone for a text on urban geography because urban planning must be integrative; it cannot separate environment, transportation, and neighborhoods, but must adopt an integrative, multidimensional perspective. Many famous plans—such as England's garden cities, the center of Paris, and Chicago's park system—encompassed multiple dimensions of planning. This is not to say that the integration always has worked or has included all needed elements, but the perspective was broad and multifaceted.

This chapter starts with the London fire of 1666 and the planning reactions resulting from it, including the world's first Building Act. At the same time, planning lessons were learned the hard way, but progress was made. The backdrop shifts to mid-19th-century New York City, which confronted a serious lack of open space. The solution, Central Park, turned out to be a milestone that gave rise to a series of improvements termed the City Beautiful movement. In the late 19th century, the next generation of urban thinkers discovered a new set of urban issues and problems; their discontent crystallized in the Progressive movement, which adopted a more formal approach to planning, including the first zoning precedents. Zoning continued to develop, becoming a mainstay of city planning.

Modern planning in the United States started in the 1920s and 1930s and emphasized going beyond a single city to encompass the emerging metropolitan areas and regions. Metropolitan agencies known as councils of governments were formed to plan for broad regions.

After World War II, the U.S. economy began an extended population and economic boom. However, that expansion put difficult pressures on many communities, leading to the concept and practice of growth management. Precedent-setting examples from the 1950s and 1960s, discussed in the chapter, are Ramapo, New York, and Petaluma, California.

The "Analyzing an Urban Issue" section concerns the spatial aspects of integrated growth management planning. The exercise introduces a multidimensional spatial approach to analyze the impacts of a plant siting and associated population growth on a fringe watershed in Chicago. The smart-growth topic from Chapter 10 is revisited in the context of planning: How can planning be done in the context of smart growth? Does it lead to urban benefits? The case example of Irvine in Orange County, California, demonstrates elements of the three major planning approaches covered in the chapter.

The discussion of planning issues in the context of urban governance and politics examines the challenges of governing cities, examples of failures in governance, and forms of governance. The city is becoming more technological. As a result, key urban technology dimensions—the Internet, telecommuting, mobile spatial connectivity, and the urban digital divide—are discussed. The final section in the chapter addresses issues of urban planning in the developing

world as presented by Mexican border cities and by metropolitan Shanghai. Understanding and dealing with these issues are essential to urban planning success for the expanding developing-world urbanization and cities of the 21st century.

11.1 ANTECEDENTS

The chapter's story of planning starts with London in the 1660s. Much of the history of urban planning is not discussed here, but the reader can access excellent sources for it (Hall, 2002; Levy, 2010; Peterson, 2003). London had been growing in the mid–17th century, from a population of 191,000 at the beginning of the century to about 400,000 by 1660 (adjusted from Chandler, 1987). Although medieval city walls framed the city, London had overgrown their extent. Its structures were mostly of wood, although a building code dating from 1189 had specified that building facades needed to be stone or brick (Platt, 2004). Earlier, in 1580, Queen Elizabeth I had recommended establishing a green buffer zone for 3 miles outside the city walls, but her proposal had been largely ignored (Hearsey, 1965).

The great London fire occurred in 1666, spreading rapidly throughout the housing stock, fanned on by high winds (Hearsey, 1965). Extending over the city walls, it also burned the city periphery on the west. There was no possibility of containing it because of lack of technology for water pumping. When the fire was quelled, most of the city within the wall was burned (Loftie, 1884). Although 100,000 people became homeless, miraculously, only four people died.

The shock of this episode galvanized the British king and Parliament. King Charles II consulted Christopher Wren, the leading architect of the time, who came up with an ambitious plan for a capital city. However, the practical king did not subscribe to this idea and instead presented a rebuilding plan having five major points (Platt, 2004):

- Street widths would be proportionate to the street's importance.
- No wood would be used on facades of buildings facing streets.
- A wide and open buffer area would be developed next to the Thames River, which would give firefighters access to water.
- Public nuisance structures, particularly a tannery and brewery, would be moved to the outskirts.
- Property owners who were restricted on public lands from rebuilding by the new design would be compensated.

A blue-ribbon panel of architects and other experts was appointed to recommend the best practices for the rebuilding (Hearsey, 1965). In 1667, the Act for Rebuilding London was approved by Parliament. This act essentially established a building regulatory code. It included four main building types, ranging from small residences to large buildings. The code keyed a particular section of street to the allowable building types. Regulations for new buildings emphasized fire prevention. The code specified exterior materials, ceilings, floors, wall thickness, room height, and the extent of roof overhangs, among other things (Platt, 2004).

The act had the weakness of lack of teeth to administer and enforce it. Nevertheless, it constituted a watershed event in urban planning history. In formalizing the government's regulatory role in a way not done before, it established a precedent for construction regulation in Britain. Many planning lessons from England were incorporated into land use planning for Philadelphia, Savannah, and other colonial American cities (Levy, 2010).

During the first half of the 19th century, North American cities were growing rapidly as a consequence of high rates of immigration and urbanization. In spite of the valuable precedents derived from Europe, and particularly England, pressing problems remained. In the case of New York City, by 1850 rapid growth had magnified the problems of urban poverty and disease (Platt, 2004). This was accentuated by the lack of sufficient open and park space. Consequently, in 1853, the New York State Legislature passed a law that called for the formation of Central Park. The 770-acre site of the park was mostly open country, located about a 30-minute walk from what was then the edge of the city, which was already 30th Street in Manhattan.

In 1858, Frederick Law Olmsted was appointed the park superintendent. A Yale graduate with a degree in agricultural science, he had not settled into a career pattern nor had he designed a park (Platt, 2004). He proceeded to submit a design for Central Park, along with one of his assistants, Calvert Vaux. To their surprise, the plan was selected. It was full of innovation—such as changes in circulation patterns to allow pedestrians to move around in the park without being blocked, while bicycles could circulate unrestricted through other routes, and horse-drawn carriages through others. The trick was including many over- and underpasses that allowed different vehicles to circulate simultaneously. At the time, Americans touted the country and rural landscapes as ideal; for example, in art this was expressed by the Hudson River School of landscape painters, who portrayed idyllic rural scenes. Central Park adhered to the ideals of the time by introducing a country landscape right into the metropolis.

The park was hugely popular and a financial success. Although it cost $14 million, it was made up within several years by the tax increases from the improved property values of housing adjacent to the park. In fact, within 10 years of its opening, the yearly increase in property tax for land adjacent to the park was $4 million (Platt, 2004). By 1871, there were more than 10 million visitors each year. With its water, meadows, and trees, the park succeeded in providing a welcome variation to the city crowding (Platt, 2004). Another outcome was the identity that Central Park lent to the whole city. Subsequently, other similar parks followed in the city, such as Prospect Park in Brooklyn, also designed by Olmsted and Vaux (Levy, 2010).

Olmsted went on to design or redesign famous parks in a dozen U.S. cities. They included the Emerald Necklace, a series of connected parks circling Boston. Although generally praised, not all of them were successful, as evidenced by the "fenway" area in Boston, which became run down. A fenway is an area that contains fens, which are low lands entirely or partially covered with water that can be drained. Late in his career, Olmsted was the landscape architect for the 1893 Columbian Exposition in Chicago (see Figures 11.1 and 11.2). He designed the monumental Jackson Park, which went along with the exposition's

FIGURE 11.1 Columbian Exposition of 1893 in Chicago: Reflecting pool. *Source:* © Bettmann/CORBIS.

"White City" building design. Although Olmsted maintained his high standards of landscape design, the overall exposition design leader was Daniel Burnham, who introduced the idea of functionalism—that is, coordinating the buildings, waste disposal, transportation, water supply, and electrical system in the plan (Platt, 2004).

The next section examines the City Beautiful movement that Burnham led. It is remarkable that these two landmark planners collaborated for the Columbian Exposition at the opposite ends of their careers.

Burnham, the Chicago architect, leveraged the opportunities of the Columbian Exposition in his first citywide project in Washington, DC, in 1902 (Levy, 2010). Washington, DC, had originally been planned in 1792 by Pierre L'Enfant, a military engineer from France, who had served with the Americans in the Revolution. It was a sweeping French design with broad and grand boulevards and stately buildings housing the principal functions of government. Two buildings, the Capitol and the White House, were placed on slight rises, connected by two straight vistas. From each major building, there was a radiating set of avenues that met in circular intersections, often also located on slight rises. By the mid- to late 19th century, the city's population had grown, resulting in overcrowding. Because the nation was becoming more complex, there was an increase in government functions, requiring additional buildings not in the original plan.

The federal government sensed a serious problem with the increasingly outmoded design and, in 1900, appointed the McMillan Commission, chaired by a senator. The other panel members were Daniel Burnham; Charles McKim, another architect; Frederick Law Olmsted, Jr., landscape architect and son of Central Park's designer; and sculptor Augustus Saint-Gaudens.

In 1902, the commission produced the first city and regional plan in the United States. The key elements were the following (Levy, 2010; Platt, 2004):

- The Mall, Washington, DC's main axis, was redesigned and replanted. It would be extended west to include additional area for the future Lincoln Memorial and reflecting pool.
- Public structures, fountains, and gardens were added to the Mall.
- Union Station, designed by Daniel Burnham, was added northwest of the mall. It largely solved the problems of the extensive rail facilities in the city center.
- A less imposing, but important, landscaping plan was developed by Frederick Olmsted, Jr. Its main feature was a network of parks along the Potomac River and Rock Creek, as well as a parkway extending to Mount Vernon in Virginia.

FIGURE 11.2 Columbian Exposition of 1893 in Chicago: Visitors in amusement park. *Source:* Corbis/Bettmann.

The plan elements were largely constructed and have proven robust over the century since. Of course, many adjustments have been made. This success was an early part of the movement known as City Beautiful, referring to efforts to augment the beauty and elegance of American cities. Other cities that Burnham subsequently led in redesigning were Cleveland, San Francisco, Baltimore, Chicago, and Manila in the Philippines.

Burnham's plan for Chicago in 1909 was especially important. It was embodied in a document written with architect Edward H. Bennett entitled *Plan of Chicago* (Levy, 2010). The key components were the following:

- Chicago's lakefront park system was installed.
- There was limited consolidation of railroad terminals.
- The Cook County forest preserve system was established. It was regarded as justified to buffer the city's anticipated rapid population increase.
- A bridge for vehicles was built over the railroad yards on the south side of the downtown Loop area.
- An important central business district thoroughfare, Wacker Drive, was made double-deck.

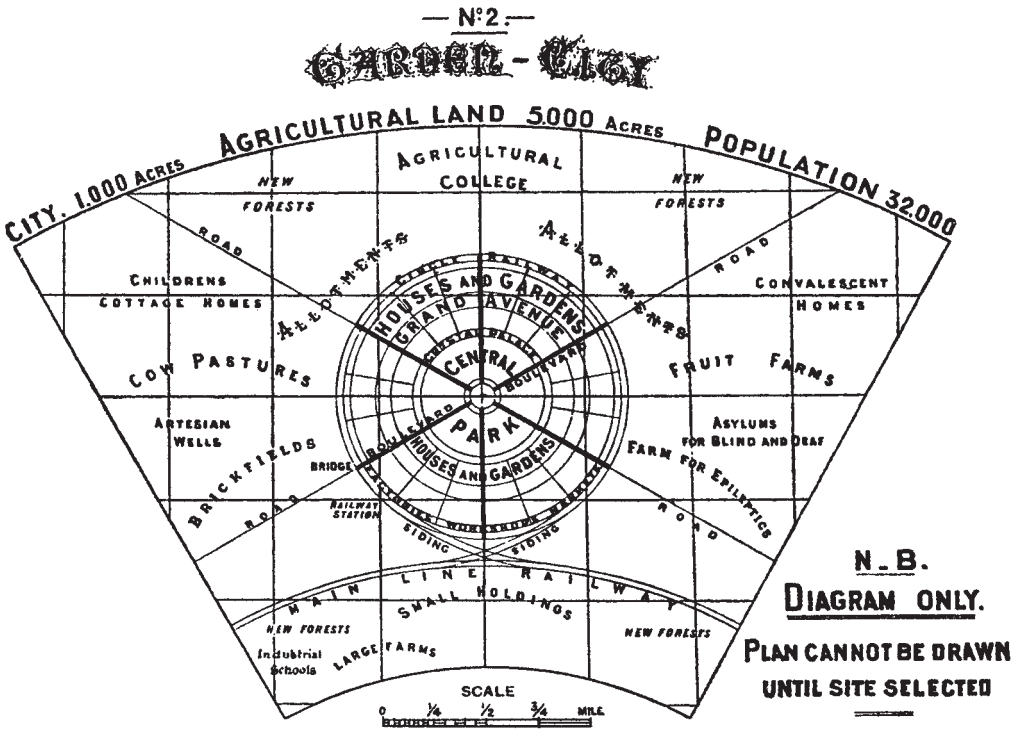
Today, elements like the lakefront parts are still crucial to the city's identity. Critics have been largely supportive, but have found fault with the plan's absorption with public spaces and lack of concern for private development (Platt, 2004).

Some argue that the visionary city planning by an Olmsted or a Burnham is largely absent in the United States today. As we will see later in the chapter, planning was brought increasingly under the regulation of government agencies and the courts, and this expanded bureaucracy is still with U.S. planning today. Consequently, the creativity and vision of these 19th-century planners might not be met. Important problems for students in urban geography to study are what are the best ideals of urban planning and how can the setting of planning encourage them.

11.2 GARDEN CITIES

The Garden City movement in England was coterminous with Beautiful Cities and emphasized towns located in the countryside. These towns were intended to reverse the direction of urban-to-rural migration streams of 19th-century England, which were overcrowding the major cities.

The Garden City concept was devised by town planner Ebenezer Howard, who published the ideas in his 1892 book *To-morrow: A Peaceful Path to Social Reform*, later retitled *Garden Cities of To-morrow* (1902). Howard had a varied career as a stenographer, law reporter, social reformer with liberal



GARDEN CITY AND RURAL BELT

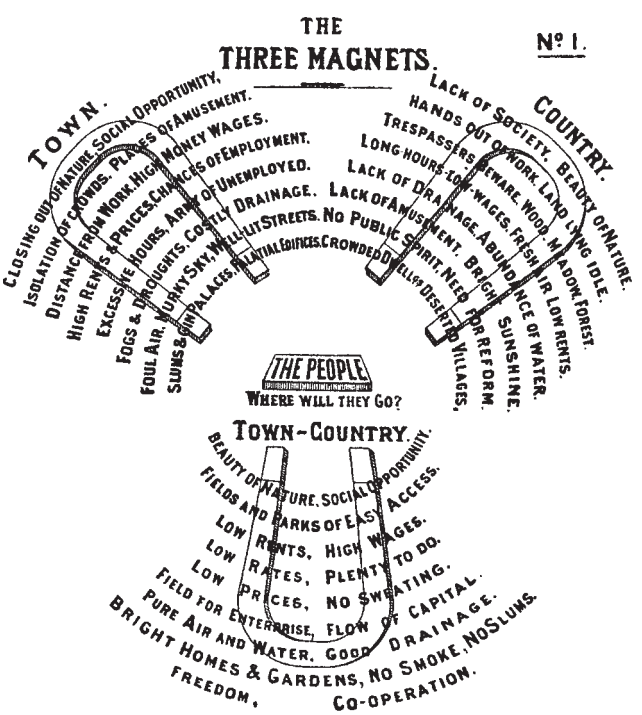
FIGURE 11.3 Ebenezer Howard's diagram for a garden city and surrounding area. *Source:* Osborn, F.J. (ed.). 1945/1965. EBENEZER HOWARD'S GARDEN CITIES OF TO-MORROW. Cambridge: The MIT Press. Reprinted by permission. Figure 6-13. "Howard's diagram of Garden City and its 'rural belt'."

views, and planner. He proposed garden cities with a population of 32,000 population that would be located away from major cities on a land plot of 6,000 acres, of which 1,000 acres would constitute the core section (Levy, 2010). He felt that the size of cities should not be accidental, but carefully defined by conscious thought (Platt, 2004).

The Garden City spatial arrangement (see Figure 11.3) consisted of a central park with cultural attractions, surrounded by residential and business sections, and an outlying large green band that is mostly agricultural. The central park area would include a theater, museum, art gallery, hospital, library, concert and lecture hall, and "crystal palace" shopping arcade (Howard, 1902; Levy, 2010). Surrounding the core was residential housing with gardens located on tree-lined avenues or interior streets. Farther out was an industrial zone, placed to avoid pollution and discourage sweatshops. It was important for the garden city to have its own economy and not be dependent on a major city such as London. The city was compact and surrounded by a green rural ring.

Its governance structure was unique. It would be privately governed as a trust or corporation by a small group of individuals on a nonprofit basis. People oriented toward philanthropy would raise funds in the investment market. The trust would own the city's land and would redirect the rental profits to improving the city on the basis of a master plan (Platt, 2004).

On a regional scale, a group of garden cities would serve to reverse the direction of city-based migration and restore population to the countryside. The idea of town and country is seen in the magnet diagram (see Figure 11.4) created by



THE THREE MAGNETS

FIGURE 11.4 Ebenezer Howard's "Three Magnets" diagram. *Source:* Osborn, F.J. (ed.). 1945/1965. EBENEZER HOWARD'S GARDEN CITIES OF TO-MORROW. Cambridge: The MIT Press. Reprinted by permission. Figure 6-12. "Howard's diagram of Garden City and its 'rural belt'."

FIGURE 11.5 Park Forest, Illinois, 1946–1952.
Source: Art Institute of Chicago (2010). Photo, "Park Forest, Illinois, 1946–1952."

Howard (1902). "Town" represents big cities with the advantages of economic opportunities, but problems of deteriorated environment and unaffordability, whereas "country" connotes a garden city with a healthy environment and natural beauty, but also with a lack of social diversity, boredom, and a weak civic environment (Howard, 1902). The "people" on the diagram appear to be torn on the choice between the town and the country.

In 1903, work started on the first garden city, Letchworth, about 30 miles north of London. It followed fairly well Howard's plan, but did not have a central garden or crystal palace. It had rigid land-use controls and was governed by a corporate structure along the lines that Howard proposed. Welwyn Garden City, less strict about Howard's plan, was built nearby in 1919. Although the garden cities did not proliferate, after World War II the New Town concept, patterned somewhat after garden cities, appeared and was more successful, with 14 eventually being developed. The New Towns Act, passed by Parliament in 1946, called for towns with a population of 30,000 to 140,000, not including the surrounding large greenbelt (Levy, 2010; Platt, 2004). The concept was adapted by other countries including Sweden, some in western Europe, the Soviet Union, and the United States.

In the United States, three "greenbelt towns" were designed and funded by the federal government following World War II. Perhaps the most successful greenbelt town in the United States was Park Forest, Illinois, done in a collaboration between government and private builders and involving most of the Garden City ideas (Randall, 2000). Park Forest in the period 1946 to 1952 is seen in Figure 11.5. Its plan responded to a housing shortage following the Depression and World War II and to the large number of returning GIs. It was as close to the planning ideas of Ebenezer Howard as any new town built after World War II (Randall, 2000).

11.3 PROGRESSIVE MOVEMENT AND ZONING

From its beginning, the City Beautiful movement engendered criticism. Its critics claimed its beauty features ignored underlying, larger problems of overcrowding, congestion, poverty, and political and business corruption. Those problems stemmed partly from the huge immigration to the United States in the 19th century, which was discussed in Chapter 7, and also from the rampant industrial corruption that muckraker journalists had so poignantly identified.

The spark of the Progressive movement was Benjamin Marsh, a political activist in New York City, who had set the goal of instilling a standard practice of city planning (Platt, 2004). In 1909, Marsh authored the first textbook on urban planning, *An Introduction to City Planning* (Marsh, 1954, first published in 1909). That same year the progressives sponsored the first national conference in the United States on modern planning (Cullingworth & Caves, 2008). The tone was practical—that is, planning was intended to reduce the stated problems through action steps. This movement raised the profile of planning deficiencies. It underscored the need for planning mechanisms to overcome congestion and other problems and led to the advent of zoning.

Zoning refers to the partitioning of land in a city by ordinance into sections reserved for different purposes. It appeared in the United States in 1916 as the result of a land use dispute in Manhattan. Merchants in the Garment District were encroaching on the space of Fifth Avenue merchants by, for example, introducing larger buildings. The Fifth Avenue merchants led a coalition to establish a city zoning ordinance that controlled the building sizes by district; this protected their environment, as well as their property values. Besides building bulk, today's zoning regulations cover land use; population and housing densities; parking requirements, especially for larger buildings; advertising signage; extraction of minerals; nondomestic uses of homes, such as for professional offices; and special environmental factors, such as wetlands (Platt, 2004). For example, zoning in a city might be based on a weighted combination of housing densities and environmental indicators (Fleissig & Jacobsen, 2002).

The use of zoning spread among municipalities, but ran into potential downsides. Although zoning protected certain stakeholders, others, such as landowners and developers, were hurt by their inability to carry out building projects and realize sales. Legal proceedings ensued, and in 1926, the U.S. Supreme Court addressed this key issue. In the famous case of *Village of Euclid v. Ambler Realty Company,* a realty company sought to challenge the zoning restrictions then in place, pointing to its potential losses related to land it owned. The legal issue boiled down to the question of which was controlling: the constitutional police power, which enabled zoning, or the 5th and 14th Amendments to the Constitution, which gave an individual reasonable use of his or her property. The Court ruled in favor of the village, so the landowner was not compensated. More specifically, *police power* permits federal, state, or local legislation that governs the health, safety, and welfare of the general public, even though it might conflict with an individual's interest, as long as that legislation is a reasonable exercise of the police power, and thus not unconstitutional.

Zoning depends on reasonableness, both in the use of the police power by local government and in the use of the land. For cities, it is crucial that a plan be put in place that justifies the zoning options selected; otherwise, a court might not recognize

TABLE 11.1 Residential Zoning Classes for the Town of Fairfield, Connecticut

Residential Zoning District	Permitted Use	Minimum Lot Size
AAA	Single detached dwelling for one family	Two acres
AA	Single detached dwelling for one family	One acre
R-3	Single detached dwelling for one family	20,000 square feet
R-2	Single detached dwelling for one family	14,000 square feet
A	Single detached dwelling for one family	9,375 square feet
B	Single detached dwelling for one family	6,000 square feet
B	Single detached dwelling for two families	9,000 square feet
C	Single detached dwelling for one family	5,000 square feet
C	Single detached dwelling for two families	7,500 square feet
C	Single detached dwelling for three families	10,000 square feet
C	Single detached dwelling for four families	12,500 square feet

Source: Town of Fairfield, 2009.

that the zoning is reasonable. This accentuates the connection between zoning and planning. Zoning is usually implemented by a planning commission, which is a group of experts appointed by the city council. Disputes are referred to the board of appeals, a city unit that tries to resolve differences before they go further in the legal arena.

Zoning is based on three major factors: the use of private land, density of structural development per land unit, and bulk of buildings (Platt, 2004). Using specific criteria, a city can create dozens of zoning classes (Levy, 2010). The usual major classes are residential, commercial, and industrial, but the zoning categories can get much more refined. For instance, the residential class might apply if housing unit density is more than three per acre. An example of zoning classes for the town of Fairfield, Connecticut, is given in Table 11.1 (Town of Fairfield, 2009).

Zoning is a constitutional police power that is delegated by the federal government to the state government and then to cities. Federal land is exempt from zoning, but state land varies; sometimes it is exempt, whereas at other times, it depends on state law. An interesting question is how municipalities do zoning of their own land; the answer is that they can easily amend their own zoning laws to accomplish zoning of their own land (Platt, 2004). Zoning provides long-term stability of land use in parts of the city for existing residents and owners and is more difficult to challenge legally than planning (Cullingworth & Caves, 2008). Zoning has the advantages of providing adequate government services such as sewage and controlling densities and crowding, but zoning is by its nature exclusionary, which has sometimes led to legal challenges (Cullingworth & Caves, 2008). In the United States, zoning rules are enabled by state law and are enforced by units in the local constituency, which go under a name such as planning commission or zoning commission.

The practical experience over many decades with zoning has led to a body of experience and certain continuing issues. A legal pattern is that courts, over a long time, have generally tended to favor the zoning ordinances, so long as they are connected to city plans. A controversial part of zoning is the "taking" issue. This issue concerns the extent to which zoning regulations can reduce the value of a property without compensation to the owner (Levy, 2010). It is backed up in the 5th Amendment, which states, "nor shall private property be taken for public use without just compensation." Over the past 75 years, many disputes and law cases have evolved around taking, with no certain outcome on either side. It depends on the reasonableness of the zoning, connection to planning, and extent of anticipated losses.

Governments have misused zoning to accomplish objectives not keyed to city planning. For instance, the NIMBY ("not in my backyard") attitude implies that a certain set of stakeholders or the city as a whole wants to exclude certain parties it considers threatening. However, a municipality is biased if it uses zoning to satisfy NIMBY complaints. The point is that the issue of NIMBY needs to be brought to a head in ways other than zoning. In *fiscal zoning,* the city uses zoning as a tool principally to increase its revenues, again misusing the instrument. Zoning has also been misdirected for purely political ends.

The long-term trend in zoning use is toward greater flexibility. A city can achieve this by frequently reviewing zoning classification, being willing to amend zoning ordinances, and granting exceptions, usually in the form of conditional use permits, which means the zoning decision is put off and made later by the appeals board. Zoning in Chicago is seen in Figure 11.6. Zoning is the standard in the United States and many other countries, but some (e.g., Mexico) utilize alternative approaches. Zoning has the advantage of aspiring to achieve fairness and completeness, but it also tends to reduce the creativity of urban planning. For example, zoning regulations would likely have halted such creative thinkers as Frederick Olmsted, Sr., and Ebenezer Howard.

FIGURE 11.6 Zoning in downtown Chicago.

11.4 MODERN PLANNING: METROPOLITAN AND REGIONAL PLANNING

From the 1910s through the 1950s, U.S. metropolitan areas were growing, and the metropolitan concepts discussed in Chapter 4 were taking hold. Cities began to expand more into their suburbs, extending past their city limits. From a planning standpoint, it was no longer enough for the city planning commission to focus on what was within the city limits. Neighboring suburbs and cities had to be considered as well. In 1928, the federal government recognized this in the Standard City Planning Enabling Act published by the Department of Commerce (Levy, 2010). It recommended, among other things, that a local planning commission consider in its master plan the areas outside the immediate city territory that "bear relation to the planning of such municipality" (Platt, 2004). Another milestone was the first metropolitan plan, the Plan for Greater New York of 1929, which was sponsored by New York's Regional Plan Association (Platt, 2004).

There were many stakeholders in the metropolitan and regional setting, and many views and opinions on the importance of coordinated planning—an issue still with us today. Inevitably, the courts would be brought into play, which happened with a landmark court decision in New Jersey. Mount Laurel, New Jersey, was a rapidly growing and sprawling 22-mile-square township with mixed developments and agricultural uses. It had zoned its remaining agricultural land for industry purposes, a move intended to lower average property taxes and appeal to existing landowners. However, this meant that newcomers faced higher land prices. Mixed housing, including affordable low-cost housing, was discouraged. The court ruled that the township had to include a range of land offerings at different pricing levels (Platt, 2004). This was a major victory for regional planning as it meant that New Jersey municipalities were forced to take a broader metropolitan and regional perspective.

After World War II, there was continuing metropolitan expansion. The federal government, including the U.S. Census Bureau, recognized this in 1949 by establishing standard metropolitan areas, retitled in 1959 as standard metropolitan statistical areas (SMSAs). Reflecting this real-world growth, in 1957 Jean Gottmann published his famous article "Megalopolis, or the Urbanization of the Northeastern Seaboard," which gave a new name to the series of metropolises in the Northeast (Gottmann, 1957). In the decades following the Cresskill decisions, there was an even greater planning thrust toward covering the whole metropolis and region. These developments were implemented by counties collaborating, states encouraging changes, and the federal government providing support.

Planning agencies for groups of cities and counties appeared more frequently in the late 1950s, 1960s, and 1970s. The federal government supported their development by giving substantial funding through the 1954 Housing Act (Section 701) to form councils of government (COGs). The federal funding for COGs was plentiful from 1954 to the beginning of the Reagan administration in 1981, when it largely expired, leaving the COGs to face rough times (Pincetl, 1994).

An example of a COG is the San Diego Association of Governments, known as SANDAG (see http://www.sandag.cog.ca.us). It was formed in 1966 on the basis of a joint powers agreement between San Diego County and the State of California. Its members have come from the city governments within San Diego County, and its mission has been to provide areawide planning and coordination. Starting with a focus on population, economy, and development, it has added many metropolitan planning elements over time (SANDAG, 2009). They are summarized in the *Regional Comprehensive Plan for the San Diego Region* (SANDAG, 2004), a shared vision of San Diego County and 18 cities that is based on smart growth and includes transportation, public infrastructure, sensitive lands, land use, urban forms, waste management, transportation, energy, water, issues of the United States–Mexico border, growth forecasts, and an assessment of sustainability. Today, SANDAG is a sophisticated metropolitanwide planning unit utilizing census and other data through advanced GIS capabilities. A COG public meeting is shown in Figure 11.7.

Other types of metropolitan and regional planning entities include economic development commissions, transportation districts, and river basin commissions. These are usually consortia of groups from municipalities and counties, with varied funding drawn from federal, state, and local sources (National Association of Regional Councils, 2009). For instance, large metropolitan areas often have special districts for air pollution control and water resources that cover their whole metropolitan area or a broader region. The South Coast Air Quality Management District (SCAQMD; see http://www.aqmd.gov), originally founded in 1957 and consolidated in 1977, carries out air pollution planning, regulation, enforcement, monitoring, technology development, green solutions, and education initiatives for 17 million residents in four counties of southern California. River basin commissions such as the Ohio River Commission coordinate and manage water resources in multistate and multicity regions. For transportation planning, states have often kept control, sometimes coordinating with regional and metropolitan transportation councils. Challenges include understanding land use and its relationship to transportation, assessing impacts of suburbanization, moderating traffic congestion and dangers, providing effective parking, and managing transport demand (Cullingworth & Caves, 2008). Finally, master planning by private companies has sometimes played a role for metropolitan areas and regions. In summary, metropolitan and regional planning grew during the 20th century,

FIGURE 11.7 Public meeting of a regional planning association of governments.

responding to the steady expansion of cities into metropolises and the development of closely spaced metropolitan areas in certain regions. Courts often backed the need to take a broader metropolitan perspective. The federal and state governments encouraged and funded new entities for regional planning.

11.5 GROWTH MANAGEMENT

Growth management, a planning approach introduced in the late 1960s and early 1970s, responded to the decades of post–World War II high fertility and economic growth, including the original baby boom of 1946 to 1964. Growth management was the response of cities to the possibility that they would be overwhelmed by the challenges of rapid population increase, but it raised issues of the rights of private developers, as well as the potential barriers to low earners where community real estate prices and rental rates were high.

Growth management differs from zoning; zoning focuses on the situations of individual owners and parties, whereas growth management focuses on stakeholders across the area as a whole. Another contrast is that zoning usually occurs in piecemeal steps independent of possible effects on overall growth, whereas growth management focuses more on overall municipal or metropolitan objectives. As with zoning, growth management has constitutional constraints, as illustrated by the Ramapo and Petaluma cases discussed later.

To implement growth management, a municipality has a number of available control options. The major categories are as follows (modified from Fulton, 2005):

- *Control of population size through housing restrictions.* Restrictions can be established on housing permits, or policies can be created that favor sites in neglected areas of the central city, referred to as infill.
- *Zoning control.* For example, a city can downzone certain city zones to industrial uses. Once industry has been established, this puts constraints on developers' ability to upzone later for residential projects.
- *Control of total floor space.* This uncommon technique involves putting annual total caps on floor space for residential and commercial development. In California, it has been done in Santa Monica, Pasadena, and San Francisco.
- *Infrastructure control.* The city specifies that new development can be undertaken only if it does not significantly impact infrastructure.
- *Political control.* Growth is directly voted up or down by a general ballot of citizens, the city council, or the board of supervisors. On the ballot, you might be asked to vote for or against growth.
- *Control by a growth management element in the general plan.* This element defines the growth management goals, objectives, measures, and steps.

In growth management situations, there might be multiple agencies involved at different levels of government. For instance,

a state transportation agency's policies might constrain growth for a city.

Growth management is subject to modification by the courts. One famous early case involving the city of Petaluma, California, established many of the precedents (Cullingworth & Caves, 2008). In Petaluma, located 40 miles north of San Francisco, new housing units between 1970 and 1971 jumped from 300 to 891 units. In 1971, the city approved a temporary stop to development to allow time for adoption of a growth management plan (Fulton, 2005). A year later a plan was approved that called for a maximum development of 500 units per year. At the same time, the city developed a multicriteria system of points to determine which development projects could be approved. The criteria included "access to existing services which had spare capacity, . . . excellence of design, . . . provision of open space, . . . inclusion of low-cost housing, and . . . provision of needed public services" (quoted in Cullingworth & Caves, 2008, p. 156). Imposing the criteria slowed growth and also led to an 8 to 12 percent proportion of low- and moderate-cost housing for the 500 units approved (Cullingworth & Caves, 2008).

Developers were upset and brought a lawsuit, which eventually reached the U.S. Court of Appeals. Ruling in favor of the city, the court stated that Petaluma's growth management policy was a proper use of its "police power" (Fulton, 2005). It noted that, although the city's plan was somewhat exclusionary, so was any zoning approach. Including some of the low- and moderate-income housing had helped influence the ruling in favor of the city.

Since this landmark decision, many disputes on growth plans have come before the courts; in most cases, plans have been supported, with the crucial factors being whether there is enough planning to back up the policy and whether the plan's housing provisions are sufficiently inclusive. The point system developed by Petaluma and other cities has been repeated by many communities, although Petaluma itself later dropped it after population pressures subsided. Some court rulings have gone against growth management, especially if planning was weak or policies appeared to be exclusionary.

It is evident that growth management is not simple, since it is connected to many external factors such as state and federal policies, real estate markets, and demographic booms and busts. State policies influence growth management approaches as well. For example, in California, growth management in coastal municipalities is constrained by the California Coastal Commission, an agency with special powers to regulate coastal lands. Oregon has mandated growth management planning for all of its counties. There has been a statewide concurrence that its cities cannot become oversized, as Oregonians perceived happened in California. Furthermore, all of Oregon's 241 cities have adopted urban growth boundaries (UGBs), which must be approved by a state commission. As discussed in Chapter 10, the metropolitan area of Portland had mixed success with the UGB, since its growth, although moderated, is still fast; suburbanization has increased; and the UGB support for greater public transportation did not lead to reductions in private automobile use. Politics, regulations, laws, and a voting measure passed and repealed to compensate landowners for UGB-related losses impacted the UGB approach during the 2004–2007 period, but the UGB emerged intact and strong (Jun, 2004; Berger, 2009). The UGB policies have led Portland's four metropolitan counties to work together in 2010 to plan greater Portland's urban land use for 50 years. By contrast, Hawaii, at the state level, has an unusual centralized system of state land-use control. In summary, growth management is not just a local prerogative, but is influenced by state policy and other forces.

11.6 ANALYZING AN URBAN ISSUE: LAND USE PLANNING

In the lab exercise for this chapter, you apply what-if analysis to the location of a cell phone plant, considering its impact on land use and population distribution within the Blackberry Watershed west of Aurora, Illinois. The lab begins with computing the overall population growth rate of the watershed on the basis of historical data. Next, a series of what-if environmental and economic assumptions are made as to how the population growth rate will be allocated spatially to the census block groups within the watershed. Finally, the resultant spatial distribution of population is projected into the future and mapped with GIS technology. This exercise challenges you to use more-sophisticated analysis functions of ArcGIS to arrive at an integrated spatial model that outputs the spatial population distribution. The exercise also draws on your conceptual knowledge from this chapter on, in particular, growth management, zoning, and environmental aspects of planning.

This type of what-if analysis is sometimes known as sensitivity analysis. What-if refers to the outcome of making assumptions about urban parameters. In the lab, we make the assumption that a plant will be located in the watershed (the "what-if") and examine what the implications are.

Cities, counties, COGs, special planning agencies, and other planning units frequently undertake what-if analysis and problem solving. GIS is a helpful tool to utilize because it goes beyond just the magnitudes of impacts to show their spatial distribution. As we have seen in the last chapter and this one, it is often the locus of impacts that is the key source of local controversy. For instance, if impacts can be located away from cities in an abandoned or unused area, public controversy might be reduced, although it usually is not absent.

Consider the contrasting example of what-if planning applied to population growth impacts in Hervey Bay Township along the east coast of Australia (Pettit, 2002). The township had been impacted by rapid population growth, an increasing number of immigrants, more community diversity, an older age structure, and rising tourism (Gillam & Taylor, 2001). It needed a tool to cope with the impacts of this growth on its environment, land use, and economic development.

It utilized a GIS system with ArcGIS software and a decision-planning add-on called "What If? 1.1." Inputs from federal, state, and local planning agencies included cadastral land parcels; footprints of buildings; road, sewer, and water lines; land use; vegetation cover; national parks and state forests; coastal wetlands; the extent of prime agricultural land; open space; and areas of significance to native population (Pettit, 2002). Hervey Bay's City Council in turn indicated what its

priority ratings were for suitability factors. The priorities represented users' assumptions about the nature and policies of land use—for example, whether the city should be kept compact or development should be allowed to be scattered outside the city limits in adjacent areas.

Two outcome maps were produced, under different growth assumptions. The first outcome map showed the implications of allowing a *growth scenario*. With no land use controls, the growth occurred beyond the city limits and outside of the map window pictured (Pettit, 2002). The city's greenbelts were maintained and the many undeveloped land tracts were left intact on the fringe. In the *compact growth scenario,* the growth took place within the city limits, particularly filling in many of the green areas and also causing residential development in rural-urban fringe areas. After comparing the two GIS map outcomes, the council determined that the city limits would need to be expanded to achieve the objectives of maintaining green spaces and having compact growth within the city limits. This Hervey example should assist you in gaining a broader understanding of the usefulness of integrated GIS-based what-if planning prior to undertaking the chapter exercise.

11.7 PLANNING FOR SMART GROWTH

Smart growth, sometimes called new urbanism, was introduced in Chapter 10. This section follows up by focusing on the planning for smart growth, including an example of it; it also considers criticisms of smart growth and compares it to the other planning paradigms of metropolitan and regional planning and growth management.

Smart growth encourages compact development with mixed uses, redevelopment of infill areas and brownfields, natural resource conservation, pedestrian friendliness of walkways (see Figures 11.8 and 11.9), mass transit, access to locally grown food, high-quality parks connecting neighborhoods, and architectural designs that encourage social interaction and respect the regional and local history (Barnett, 2007a; Ellis, 2002; Farmer, 2007).

FIGURE 11.8 Wide suburban street with no sidewalks, under the assumption of little or no walking. *Source:* Ellis, C. (2002). "The new urbanism: Critiques and rebuttals." *Journal of Urban Design* 7(3):261–291. Figure 3, "A wide suburban street with no sidewalks," p. 265.

FIGURE 11.9 Pedestrian pathway in Kentlands, Gaithersburg, Maryland. *Source:* Ellis, C. (2002). "The new urbanism: Critiques and rebuttals." *Journal of Urban Design* 7(3):261–291. Figure 4, "Pedestrian pathway in Kentlands, Gaithersburg, Maryland," p. 265.

The planning for smart growth emphasizes compactness, environment, and quality. In the United States from the end of World War II by and large until the present decade, government and industry have favored urban sprawl, automobile transport, reduced walkways and bike ways, and energy and water wastage (Barnett, 2007b; Farmer, 2007). This succeeded because, until recently, open land on the periphery was available, highways were built, energy was cheaper, and regulations and incentives favored these patterns. The big planning challenges to overcome, such as accommodating the interstate highway system and growing the nation's energy capacity, were tackled successfully. Negative consequences of this "dumb growth" (Farmer, 2007) were the neglect of planning and development for poor downtown areas; a reduction in physical exercise, partially causing increased obesity and other health problems; traffic congestion; and environmental impacts, especially air pollution and greenhouse gas emissions. Smart growth responds to—and if widely adopted, can correct—most of the weaknesses of the earlier emphasis on sprawl.

The keys to the success of smart-growth planners appear to be the following (Ellis, 2002):

- Open up the project for discussion with the impacted community and the public to educate them on smart-growth principles and gain buy-in. Include public meetings, if possible.
- Be flexible on adherence to some, but not necessarily all, of the smart-growth principles. A smart-growth purist might find it much harder to gain public support and financing.
- Use financial-planning techniques to balance objectives. One useful method to check the balance of smart-growth goals is the "Smart Scorecard" (Fleissig & Jacobsen, 2002). As seen in Table 11.2, a designer can score a range of weighted smart-growth criteria to determine the overall extent of adherence. For each criterion, specific measures can be combined to achieve a rating.
- Consider how low- and moderate-income housing demand is addressed in a smart-growth plan. Include some

TABLE 11.2 The Smart Scorecard: A Way to Weight Smart-growth Criteria

The Smart Scorecard is used by communities to prioritize their scorecard for smart-growth success (U.S. Environmental Protection Agency, 2010). Following are hypothetical weightings for one city's Smart-growth Measures.

Smart-Growth Criteria	Weighting: Percentage of Total Score
Proximity to Existing/Future Development and Infrastructure	15
Mix and Balance of Uses	12
Site Optimization and Compactness	12
Accessibility and Mobility Choices	12
Community Context and Site Design	10
Fine-Grained Block, Pedestrian, and Park Network	10
Environmental Quality	8
Diversity of Housing	8
Reuse and Redevelopment Options	7
Process Collaboration and Predictability of Decisions	6
Total	100

Examples of Specific Measures for the Diversity of Housing Criterion

Specific Measure	Rating Scale
Variety of building types and styles	Rated on 1-to-4 scale
Wide range in the pricing structure of units that will be sold or leased (at least 20 percent of units priced for 80–100 percent of average median income)	Rated on 1-to-4 scale
Varied residential lot sizes	Rated on 1-to-4 scale
Attention to the need for civic facilities and amenities, such as day care, teen/senior centers, and cultural facilities	Rated on 1-to-4 scale

Source: Fleissig, W., and Jacobsen, V. (2002). *Smart Scorecard for Development Projects*. San Francisco, CA: Congress for New Urbanism. Available from the U.S. Environmental Protection Agency (2010) at http://www.epa.gov/dced/scorecards/project.htm.

lower-cost options, especially for larger developments and city plans.

- Involve designers and builders who are experienced in smart growth and regard it as a way to achieve worthy overall city planning results, rather than primarily as a means to attain individual architectural recognition.

Another important issue in planning for smart growth is how to assure the public, as well as the courts, that this type of planning is inclusive of poor and marginalized classes, mostly in the inner city. However, there is nothing inherent in smart-growth principles that points to any particular social class. For instance, pedestrian and bicycle features and improved access to nearby markets with fresh food can be applied to a lower-class as well as a middle-class clientele.

One of the most promising areas for smart growth is infill redevelopment because it brings new design ideas to a part of the city that is receiving less attention today. This refers to projects to reinvigorate brownfields and other neglected or abandoned areas that might be located in the central city or more outlying areas. An example is the Eastgate Town Center in Chattanooga. The enclosed Eastgate Shopping Mall was built in the early 1960s in the then-new suburban neighborhood of Brainerd, located 12 miles from downtown Chattanooga near farmland (Benfield, Terris, & Vorsanger, 2001). Although it was very popular for almost two decades, Eastgate began to lose appeal in the 1980s. In the mid-1990s, the new mayor of Chattanooga addressed with the Chattanooga Regional Planning Agency the question of how to restore the largely vacant Eastgate Shopping Mall. The agency recommended that it be redeveloped to include a mixed use of offices, shops, civic organizations, and some residences (Benfield et al., 2001; Mid-America Regional Council [MARC], 2003). The winning design essentially turned the mall inside out. Shops on the ground floor were converted to have windows and face outward, whereas the mall's second floor was converted to offices with windows (MARC, 2003). A public square was added to allow walking and socialization among town center workers and visitors. The redevelopment project was approved with a price tag of $30 million. Once completed, the renamed Eastgate Town Center attracted a diverse clientele, ranging from major corporations to small businesses, a community college, the YMCA of Chattanooga, an ice rink and other recreation facilities, and some shopping. Mass transit access and pedestrian features were included. The new Eastgate Town Center was a success, with many local customers returning after years of staying away (MARC, 2003). In the process, most smart-growth proposal goals were attained, with only a few—particularly a greenway trail element—not accommodated. In sum, this case study illustrates successful design and implementation of a smart-growth project dedicated to city infill.

Critics of smart growth have doubted whether it can realize its goals. Regarding traffic congestion, smart growth has

FIGURE 11.10 Walkers in Times Square in New York City. *Source:* PhotoEdit.

been attacked as increasing suburban congestion on limited traffic arteries (Barnett, 2007b; Ellis, 2002). On the other hand, many agree that smart growth has helped traffic patterns in the central city.

Critics of smart growth also doubt that making cities more walkable actually results in people walking more, thereby making claims about health benefits questionable (Seelye, 2003). On the contrary, some reports have shown there are more walkers in compact cities such as high-density, albeit lower-smart-growth New York City, as seen in Figure 11.10 (Seelye, 2003). A study by Lawrence D. Frank of the University of British Columbia, based on 12,000 survey responses, confirmed that "people who live in areas of low building density (i.e., suburbs) tend to weigh more than people in higher-density, mixed-use areas (i.e., cities), even controlling for income, age, sex, and ethnicity" (cited in Seelye, 2003, p. A14). Compact, pedestrian-friendly cities such as San Francisco, Portland, Eugene, and Boston showed the highest walking prevalence, whereas lower-density cities such as Houston and Phoenix did the worst. In sum, the Frank study provides data that counter the walking critique.

As smart growth is a new form of urban design and planning, the debate between advocates and critics is likely to continue for some time, just as it has for zoning, growth management, and other approaches discussed in this chapter.

11.8 VIABLE DOWNTOWNS

From a building standpoint, the post–World War II slum-clearance programs tore down deteriorated inner-city housing and replaced it with multistory public housing (Barnett, 2003). These new buildings represented a way to reduce land costs per capita and also were part of the general popularity of skyscrapers at the time. However, the high-rise buildings rarely had secured entrances, leading to high crime and vandalism rates (Barnett, 2003; Newman, 1973). Another type of design in this period consisted of rows of barracks-style buildings. Barnett (2003) described them as

> a long, low row of attached duplex apartments. The apartments were like small separate houses, potentially much more manageable than a tower; but the design of the buildings as utilitarian barracks laid out in rows did not create a comfortable environment. At the time these projects were built, public housing tenants were not allowed to own cars, so there are few internal streets in these projects and wide open spaces between the buildings which became uncared for and unsafe. (p. 120)

Critics have voiced concerns about these planning practices, attacking everything from the stark design of buildings to lack of protection and encouragement of crime, energy inefficiencies, and loss of the traditional character of neighborhoods (Barnett, 2003; Farmer, 2007). Although the programs of slum clearance largely ended in the 1960s, other problems discussed in this book exacerbated the situation in the center. Low-income housing projects on the Lower East Side of Manhattan are shown in Figure 11.11. The flight from the ghetto meant that middle-class minority members departed, leaving the remaining inner-city population less educated and less employable on the average. Poverty and the underclass received attention as large

FIGURE 11.11 Low-income housing on the Lower East Side of New York City in the early 1990s.

problems in the late 20th century (Massey & Denton, 1993) and continue today, amplified by the Great Recession of 2007–2009 and its aftermath.

Better inner-city infill designs were encouraged by the Department of Housing and Urban Development (HUD) HOPE VI Program, which favored projects that apply smart growth to infill redevelopment (Barnett, 2003; Ellis, 2002). HOPE VI was launched in 1993 with the goal of redeveloping the 86,000 most run-down public housing projects in the nation by demolishing and rebuilding them into mixed-income developments having both public housing tenants and tenants paying rent at market levels (Cisneros & Engdahl, 2009; Popkin et al., 2004). The program supported and recognized housing developers, designers, and housing authorities for their work "to redevelop failed modernist public housing projects into mixed-income communities" ("HOPE VI," 2002). An example is Capitol Gateway in Atlanta, a HOPE VI joint redevelopment project of a Philadelphia design firm and the Atlanta Housing Authority, resulting in mixed-income dwellings, low-cost apartments, commercial development, and centers for learning and early childhood development ("HOPE VI," 2002). Although HOPE VI improved the quality of deteriorated housing structures, increased property values, reduced crime rates, and had a positive effect on many inner-city neighborhoods (Bellantoni, 2009; Cisneros & Engdahl, 2009), critics pointed to sometimes ineffective outcomes, political wrangling with local governments, instances of rebuilding projects in place without design innovation, and a significant proportion of original residents whose quality of life was not improved (Popkin et al., 2004). HOPE VI's funding was cut substantially by Congress and nearly phased out during the Bush. The Obama administration continued HOPE VI at low funding levels. HOPE VI has been a controversial inner-city program that was not planned well enough and has been limited by political and social crosswinds.

The Obama administration's 2010 budget included two new programs for impoverished inner cities, Promise Neighborhoods and Choice Neighborhoods. The programs incorporate ideas from HOPE VI and the Harlem Children's Zone (HCZ), as well as smart-growth concepts. Promise Neighborhoods is an interventional program based on public-private partnerships to provide multifaceted education and support to children in extremely impoverished neighborhoods. The administration funded the program in 20 locations. Promise Neighborhoods is based on the successful HCZ, which offers education and support for over 8,000 children in a 97-block area of Harlem. HCZ comprises 20 elements that enrich the students' backgrounds and the parents' capabilities on topics ranging from school study habits to pregnancy to entry into college. They include workshops on better parenting for expectant parents; health assistance to lower asthma risk; and after-school programs including technology, nutrition, dance, arts, college prep, and Promise Academics (Chicago Policy Research Team [CPRT], 2009). The latter are the first charter schools in Harlem. HCZ elementary school children benefit from extracurricular dance activities that enrich and broaden their perspectives, contributing to the foundation for college prep (see Figure 11.12).

HCZ is led by Geoffrey Canada, a Harvard-trained educator who grew up in poverty and a broken home in the South Bronx. Canada refers to the student experience sought at HCZ as "conveyor belt," meaning that it is intensive and comprehensive and covers the entire path from birth to college. Studies have shown impressive academic achievement gains for HCZ students (CPRT, 2009). The success of HCZ has been ascribed to early and comprehensive intervention, a focus on a smaller community, and Mr. Canada's leadership (CPRT, 2009). In sum, HCZ is a success story in breaking the cycle of poverty for children in the inner city.

Choice Neighborhoods, the second Obama administration program, is the modernized potential successor to HOPE VI. Its goal is to provide multiple investments in infrastructure and other areas for impoverished neighborhoods (Bellantoni, 2009). If Congress continues to support it, Choice Neighborhoods will be collaborative across the federal Departments of Housing and Urban Development, Labor, Transportation, Health and Human Services, and Education, and the Environmental Protection Agency. The program differs from HOPE VI in being more focused and selective, requiring neighborhood interventions that

FIGURE 11.12 Harlem Children's Zone: Extracurricular dance class. *Source: Washington Times.*

are catalytic in outcome, and mandating matching funds from government or private sources. Smart-growth elements are encouraged, such as housing with sidewalks, housing locations that are walkable to public transportation, and inclusion of full-service grocery stores (Bellantoni, 2009).

Programs in this area have progressed from the narrow, unfocused, but fairly successful HOPE VI investments of the mid-1990s to the Obama administration inner-city programs of 2010 that involve focused, multisource investments and incorporate smart-growth concepts. The latter programs represent the next stage in trying to break the U.S. cycle of inner-city poverty and retain inner-city residents in enhanced neighborhoods.

11.9 URBAN PLANNING CASE STUDY: IRVINE, CALIFORNIA

Over the past 50 years, Irvine, California, in Orange County, southeast of Los Angeles, has grown from open ranchland to a city with a population of 212,793 in 2009 (City of Irvine, 2009a). It has undergone this rapid growth and change through planning that has involved both government and the private sector. No one planning paradigm has been utilized; rather, the city has employed a combination of regional planning, growth management, and smart growth. This case shows how city planning might not find a simple solution to a problem in the real world, but needs to draw from a number of approaches and shift over time.

In the 1860s and 1870s, James Irvine, a San Francisco businessman, bought a very large expanse of southern California ranchlands that had originally been Spanish colonial holdings (see the chronology in Table 11.3). The land contained one of the world's largest orange groves, as well as extensive farms growing walnuts, lima beans, and avocados. The Irvine family held the land until 1977. Since 1983, the Irvine Company has been owned by Orange County and Los Angeles businessman Donald Bren (Forsyth, 2002).

In 1959, the site for the University of California Irvine (UCI) campus was selected, and the campus opened in 1965. The design firm of William Pereira and Associates did the master planning for both the UCI campus and the Irvine Ranch housing and commercial developments in the surrounding area. Hence, the first planning was done through a private company. The large size of the property was perceived by the firm as a major opportunity to demonstrate the benefits of private planning.

Orange County planners raised a number of concerns about the developer's planning proposals, including "loss of agricultural land, designs of villages, lack of specific plans for affordable housing or mass transit, traffic projections, and flood control" (Forsyth, 2002, p. 2512). The public reaction to the Irvine Company was and remains mixed, with much dislike engendered by threats to natural areas, loss of farming, and more congestion and pollution (Olin, 1991; Schiesl, 1991). The county was able to reach enough compromises to include a modified Irvine Company plan in its County General Plan in 1970. However, several of those problems—particularly the lack of affordable housing and traffic congestion—have continued to encounter opposition.

TABLE 11.3 Irvine Ranch Time Line

Date	Event
1860s, 1870s	James Irvine I buys ranch with partners whom he then buys out
1937	James Irvine Foundation formed
World War II	Military bases constructed on Irvine Ranch
1949	Housing Act
1954	Housing Act
1956	Interstate Highway Act
1957	University of California Irvine (UCI) site selection study initiated
1959	Presidencies of Irvine Foundation and Irvine Company pass to nonfamily members
1959	UCI site selected and initial planning for ranch begun
Early 1960s	Planning for Irvine
1964	Southern Sector Plan agreed to by Orange County
1965	UCI opens
1965	U.S. Department of Housing and Urban Development created
1968	Housing and Urban Development Act—creates Title VI new towns
1969	Taxation Act—affects nonprofits owning for-profit companies
1970	Irvine General Plan accepted by Orange County
1970	Housing and Urban Development Act—creates Title VII new towns
1973	Endangered Species Act
1977	Irvine Ranch sold
1983	Donald Bren buys out most others, becomes sole owner in 1996
Early 1990s	Habitat protection negotiated
Early 21st century	Smart growth Sustainable business practices

Sources: Forsyth, A. (2002). "Who built Irvine? Private planning and the federal government. *Urban Studies* 39(13):2507–2530. Table 1, "Irvine Ranch timeline," p. 2511; City of Irvine. (2009). *History of the City.* Irvine, CA: Author.

The City of Irvine was not incorporated until 1971. The original extent of Irvine Ranch was 115,000 acres (see Figure 11.13), which is about one-fifth of Orange County. Also shown is the 53,000 acres of the City of Irvine and the 1,500-acre UCI campus. By contrast, some of the Irvine Ranch land was sold off to form parts of the coastal communities of Newport Beach and Laguna Beach. They were not master planned and today are upscale communities that largely succeeded through normal city planning, without having a master plan.

From its start, the city of Irvine's plan was set in the context of metropolitan and regional growth. First of all, the rest of the Irvine Ranch property, outside of the city of Irvine in Figure 11.13, was allocated to six other cities (Forsyth, 2002), so regional and metropolitan perspectives were present from the

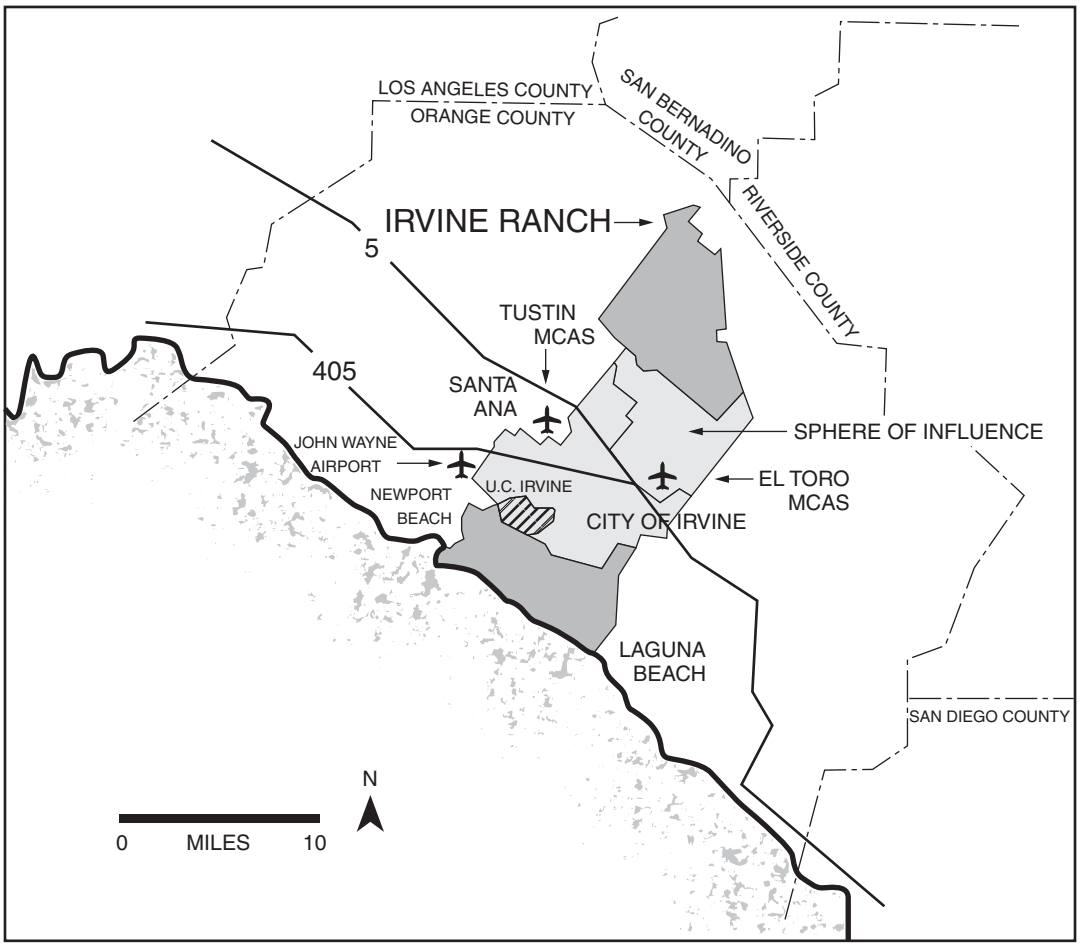


FIGURE 11.13 The Irvine Ranch: Its features and setting. *Source:* Forsyth, Ann. 2002. "Who Built Irvine? Private Planning and the Federal Government." URBAN STUDIES. 39(13). Copyright © 2002. Reprinted by Permission of SAGE. Figure 1. P. 2510. "Irvine Ranch: major features."

start. The State of California was intimately involved in planning also because of the centerpiece UCI campus (Figure 11.13).

Less obvious was the strong and multifaceted planning involvement of the federal government. At each step in the history of the last 50 years, federal government decisions, laws, and policies influenced the local planning. In 1956, the Eisenhower Administration passed the Interstate Highway Act and the accompanying energy policy. The Act commenced the building of the national highway network that included two interstate highways crossing the Irvine Ranch and eventually going through the City of Irvine. It led to enhanced automobile transport and lower energy prices. Federal education policies during the 1960s through 1980s favored public universities (Forsyth, 2002). Military policies during World War II resulted in the siting of El Toro Marine Station on Irvine Ranch property, and the base was favored with more development during the Cold War. In the 1980s, federal environmental policies influenced contentious environmental disputes that erupted between the Irvine Company and the city (Olin, 1991). The environmental planning disputes centered on tensions between environmentalists and the Irvine Company leadership (Forsyth, 2002; Inman, 1998). The issue that aroused the most strident reaction was the question of protection of endangered species habitat. The company opposed federal restrictions on wetlands development, but eventually had to give in, despite its own efforts to demonstrate a wetlands solution (Forsyth, 2002). The matter was eventually largely settled by a series of company gifts of large land acreages for wildlife preserves (Forsyth, 2002). In 2006, the Irvine Company agreed to the designation of 37,000 acres of mostly Irvine Ranch land to be a National Natural Landmark and a California Natural Landmark (Office of the Governor, 2006), which secures permanent protection with land ownership held largely by the Irvine Company. The status of landmarks is granted after intense scientific scrutiny to validate rarity of biological, paleontological, and geological features.

The Orange County Great Park is another example of the federal influence. This transformation commenced with controversies that followed the closure of the El Toro Marine station in 1993 (Orange County Great Park, 2010). Although the land was voted in 2000 by the Orange County electorate to become an international airport, opposition developed and several new opposing propositions were proposed, voted on, and legally challenged; a large park was finally approved by county voters in Measure W in 2002. The land of the Marine Station was annexed by the City of Irvine in 2004, with one fifth of the land to remain under jurisdiction of the Federal Aviation Administration. A year later, the rest of the land was auctioned

to Lennar Corporation, a private development company. The company immediately gave the City the land for the Great Park but will develop residential and commercial projects surrounding it. A non-profit agency formed by the City of Irvine, working with the city's planning commission, has design and planning control of the park (City of Irvine, 2010). The park, designed by architect Ken Smith, amounts to 1,347 acres, twice the size of Central Park in New York (Emery, 2010). Public and private funding to support the Park's over $1.4 billion cost was slowed by the Recession of 2007-2009. The park is projected to undergo its major construction in the middle of the 20 teens decade.

Irvine would have seemed to be a candidate to adopt a long-term growth management approach, but that was not the case. The city grew very rapidly in the 1970s and 1980s, going from its original population of 14,231 in 1971 to 127,200 in 1996, and continued to increase moderately to 212,793 in 2009 (U.S. Census Bureau, 2010). Rather than growth management, the city strongly advocates smart growth with a mixed-development approach that can be sensed in the city's mission statement in Table 11.4 (City of Irvine, 2009b). The city shifted in the early 21st century to strongly advocate smart growth and sustainable planning and actions. This picked up on earlier city provisions for a pedestrian-oriented city, smoking ban, and environmental planning. Among the city actions taken since 2005 are provision of 60,000 compact fluorescent lightbulbs to citizens (2006 to 2008), a zero waste city council resolution, a construction and demolition ordinance for sustainable practices, formation of the city's Green Ribbon Environmental Committee, energy plan adoption, and budget approval for a climate action plan. The city has emphasized sustainable construction at a high standard for new buildings and sustainable retrofitting of existing buildings through passive insulation, shading, and renewable energy use. The county's Great Park, located in Irvine and its surrounding neighborhoods, will meet high LEED sustainable architectural standards.

The smart-growth planning approach, although not openly espoused by the city, is evident in many of its planning policies and outcomes (e.g., the business park pictured in Figure 11.14). They emphasize environmental quality, housing diversity, mixed uses, and smart forms of mobility (e.g., Irvine has extensive bike paths). The city took a vocal and forceful stance on annexing and redeveloping parts of a huge infill site, the El Toro Marine Station (Villanueva, 2003).

This case demonstrates that a community can be planned over time on the basis of a somewhat shifting variety of paradigms—here mixing the metropolitan, regional, private-sector, and smart-growth approaches. The resultant city of Irvine has been remarkably successful in a short period of time, garnering awards for outstanding educational rankings, green initiatives, accessibility for persons with disabilities, transportation, technology, and home design (City of Irvine, 2009a). The Irvine Company represents an instance of private master planning of a community, blended with strong city government planning. The inevitable conflicts have been intense, but have been mostly resolved through each side giving way on some items. Although in many respects over the past 40 years the city has realized growth management, it puts increasing emphasis on smart growth.

TABLE 11.4 City of Irvine Mission Statement

The Mission of the Employees of the City of Irvine is to create and maintain a community where people can live, work, and play in an environment that is safe, vibrant, and aesthetically pleasing.

Source: City of Irvine. (2009b). *City of Irvine Mission Statement.* Irvine, CA: Author. Available at http://www.cityofirvine.org.

11.10 URBAN GOVERNANCE AND POLITICS

Cities face many problems that challenge their capability to manage and govern. This chapter has examined the challenges of planning, including such factors as population growth, environment degradation, maintenance of appropriate mixtures of land uses, and introduction of smart growth that is affordable. So far, they have been examined as questions confronting planning agencies. More broadly, the solutions to these and other local and regional issues are addressed through urban governance and politics. *Urban governance* refers to the structures and actions by which a city or metropolitan area manages and provides leadership in its public processes. Because urban governance is usually led by politically elected officials and representatives, urban politics is associated with governance. This section first looks at the broad economic problems facing urban governance and how they can be resolved and then discusses the alternative forms of governance. The importance to urban geography is that much of the functioning of urban areas depends on, or interrelates with, municipal governance and political actions. Also, many, if not most, municipal government actions are spatial, such as deciding on municipal service provision, collecting taxes, and conducting environmental monitoring.

A fundamental challenge for urban governance is how to pay for it. This challenge applies to every form of government discussed later—whether a city, metropolitan, or cooperative structure. In a time of economic crisis, several of these forms of government might be looked at to provide funds. Funding of urban governance comes from a mixture of taxes, fees, borrowing, and revenue sharing involving larger public units such as state and federal governments. On the other side of the income statement are costs, including payrolls, services, welfare, and financial debt service. City and urban governance must balance these inflows and outflows from year to year.

Economic cost pressures arise from the following factors, among others: pressure for pay raises from government workers, demand for more welfare payments, costs related to urban area growth, costs of maintaining and upgrading deteriorating infrastructure, and reductions in revenue sharing and grants from state and federal governments. As seen in Chapters 6 and 7, during the past two decades, many large U.S. cities experienced high immigration inflow, which added to the pressure on their city services and welfare. In the first decade of this century, the largest generation ever, the baby boomers, began to retire, which increased strains on city services while reducing tax funding.

Examples of urban economic stress at the breaking point were the New York City fiscal crisis of 1975 and the Orange County, California, bankruptcy of 1994. In both cases, certain costs grew, while revenues were not able to keep up.

FIGURE 11.14 Environmental features of business park, Irvine. *Source:* PhotoEdit.

Government officials were not alert and action-minded enough to prevent severe crises.

For New York City, the immediate cost increase was growth in welfare recipients (Knox, 2003). By fall of 1975, the city had a cumulative operating deficit of $2.5 billion. This shortfall was too large to be filled by financial borrowing, and the federal government under President Gerald Ford refused to intervene (Knox, 2003). The city averted looming bankruptcy only when the New York State Legislature stepped in to bail out the city. To achieve a long-term solution, the legislature established a recovery management entity, the Emergency Financial Control Board, led by the governor and major bank executives, as well as the Municipal Assistance Corporation, a financial entity to locate and arrange borrowing. Eventually, over a number of years, government austerity measures and improved management, combined with late-arriving federal funding, brought the city back to financial normalcy.

Orange County, California, which includes the city of Irvine as well as dozens of other cities, was forced into the largest municipal bankruptcy in U.S. history in December 1994. The immediate reason was that its county treasurer had been allocating county funds for speculative investments instead of following the usually conservative investment approach of the vast majority of municipal governments. Ultimately, the investment losses reached $1.7 billion, forcing the bankruptcy. Besides irresponsibility, an underlying reason for this speculation was California's passage in 1978 of Proposition 13, a citizens' referendum that put a 1 percent lid on California residents' property taxes. After it went into effect, municipalities did not take steps quickly enough to reduce their costs proportionately, so that some developed mounting year-to-year deficits (Public Policy Institute of California, 1998). Other underlying causes of the crisis were political fragmentation and lack of attention to financial oversight by county political leaders and managers (Public Policy Institute of California, 1998). It took years of stringency for Orange County to emerge from bankruptcy and get back on a normal pathway. The lesson is that economic distress can lead to desperate measures and cover-ups unless the political leadership takes on its full responsibility. In the Great Recession of 2007–2009, numerous city budgets across the country suffered serious cutbacks, resulting in reduced programs and services. For instance, impacted by the recession, the City of Los Angeles in 2009 suffered a $530 million budget deficit relative to an $18.2 billion budget, leading to layoffs and the reduction of many vital services (City of Los Angeles, 2010). These examples illustrate the challenges of urban governance and politics.

Urban geography is also concerned with the types of city and metropolitan government and political structures that exist. The four major types of urban governance are the single-tier, two-tier, cooperative, and corporatist forms (Goldsmith, 2001).

Single-tier governance refers to a single, unified government for an entire urban area. Examples in the United States are San Diego, Phoenix, Houston, Dallas, Oklahoma City, and Kansas City (Goldsmith, 2001). Single-tier government grows largely through annexation. As discussed in Chapter 2, the potential for annexation is often unfavorable. If the urban area is underbounded, having substantial suburban population that does not support annexation, single-tier governance becomes unfeasible. The *two-tier* approach involves a government system that is integrated for a whole metropolitan area (Goldsmith, 2001). In the

United States, this might take the form of county government. For instance, Orange County is the metropolitan government for its municipalities. For the Miami area, the metropolitan government is Miami–Dade County. In some cases, the metropolitan government has been formed or reinforced because of crises. For example, Toronto's two-tier metropolitan government was formed as the result of a financial crisis of the municipalities of Toronto (Goldsmith, 2001). In London, England, mounting traffic and infrastructure problems in the 1960s led to formation of a two-tier system, which was abolished two decades later.

A third form of metropolitan government is *cooperative governance*. This consists of a cooperative arrangement among various institutions in the municipalities of a metropolitan area. Usually, cooperative government is the grouping of various entities to manage a particular function—for example, air pollution, regional planning, or finances. An example of a multicounty planning organization already mentioned is Southern California Association of Governments (SCAG) for five southern California counties. In London, after its two-tier system was abolished in 1986, a cooperative agreement was set up between London and its former two-tier municipalities. Such cooperative bodies do not replace the full-fledged city or metropolitan government, but they can offer complementary strengths. One evaluation of their pluses and minuses indicated that councils of governments perform better at providing services than at extracting revenues (Holden, 1964).

Another form of governance is *corporatist,* which involves a symbiotic relationship between government and private and nonprofit entities, such as businesses, community organizations, and labor organizations. Often, for the corporatist approach, the government depends more on professional technocrats to run it. The corporatist approach was encouraged following the fiscal crises in American cities in the 1970s and 1980s (Knox & McCarthy, 2005) because greater efficiencies were being sought.

The corporatist approach frequently involves *privatization,* which is the outsourcing of formerly government services to profit-making companies. Rising privatization of government services was seen in state governments in the United States, for which private-sector services grew from $27 billion in 1975 to $150 billion in 1992 (Knox & McCarthy, 2005). Similar growth occurred for cities and metropolitan areas. Among the advantages to city and metropolitan governments of privatization are the sharing of financial risks with businesses, higher productivity through reduced costs, and the easing of year-to-year financial jolts. On the other hand, privatization can lead to "low balling" by private contractors, in which a contractor comes in with a low bid to obtain the contract, but with the intent to raise the bid quickly afterward. Also, the city needs to assure that the cost lowering of privatization will be maintained for the long term. Another issue can be low performance by service providers. This is offset through the government's continual monitoring and quality control of the providers.

For the corporatist approach, cities have sometimes been entrepreneurial, working in association with businesses to develop large-scale public centers of different types. Although the outcomes vary, well-known examples of corporatist success are Quincy Market in Boston, Riverfront in Savannah, Pioneer Square in Seattle, and South Street Seaport I in New York City (Knox & McCarthy, 2005). They offer the combined features of retail businesses, restaurants, museums, concert and performance halls, tourist venues, and high-quality office complexes. Similar entrepreneurial joint projects are sports complexes, convention centers, and large-scale urban mall developments in many cities.

City and metropolitan governance varies also along a range from elitist to pluralist. *Elitist* refers to government arrangements that are controlled by a small elite, which might consist of leading politicians, leaders of elected representatives, and business leaders. An example of a city that has tended to be more elitist is San Diego (Knox & McCarthy, 2005). At the other extreme is *pluralistic* governance, in which power is spread among many political interest groups. For instance, Metro in Portland, Oregon, a topic of Chapter 10, was founded to give voice to many constituencies in forming a vision for the area (Metro, 2010).

11.11 TECHNOLOGY

Technology is crucial to urban planning and development and to the activities of cities. Rapid advances in information and computing technology (ICT) over the past several decades have significantly influenced urban areas. One consequence of ICT is that the world's cities and their residents are being drawn much closer together. The new technologies influence work, home, and leisure activities. They encourage a trend of telecommuting in cities, meaning that employees can do part of their work away from corporate premises, in their homes or on the road. Mobile devices such as cell phones have leapfrogged over older technologies and expanded the communications channels for urban workers and residents. Technologies such as GIS, satellites, automated surveys, urban databases, and census data collection devices strengthen the study of and knowledge accumulation about cities. Technologies have not always performed well in cities, but the trend is toward improvement and benefits. The new technologies do not affect all urban residents equally. Some benefit and some are left behind, a division referred to as the *digital divide.* This section focuses on the topics of the urban Internet, telecommuting, mobile devices, and the urban digital divide.

11.11.1 The Internet and the City

The commercial development of the Internet started in 1994, when Netscape Communications Corporation was formed to commercially develop the Mosaic browser, originally created at the University of Illinois. In 15 years, it expanded worldwide, with several billion users and high-speed communications channels circling the globe. Urban geography must examine how Internet, web, and mobile connectivity affect the city and its infrastructure, information flows, work habits, leisure, and communications, as well as recognizing where disparities exist.

Some concepts and definitions are given first. *Physical space* refers to the earth's natural and man-made features and objects—for instance, a car moving on a road. *Virtual space* refers to the information, communications, and social interactions taking place over the Internet. It does not necessarily have a physical location. However, it is closely related to physical space because it depends on the infrastructure, land, buildings, and people located in physical space to support it. In comparing these two concepts of space, Kellerman (2002) divided them into three dimensions: organization, movement, and users,

TABLE 11.5 Differences in Physical and Virtual Spaces

Characteristic	Physical Space	Virtual Space
Geography—location Geography—relationships	Based on earth coordinates Spatial rules of location	"Virtual arrangement" based on internet addresses" no physical relationships in geographical space
Collaborative structure	Participants are physically present in one location	Participants can be separated anytime, anywhere
Collaboration quality	Based on actual behavior and performance of physical participants, trust, and motivation	Based on perceived behavior and performance of virtual participants, trust, and motivation
Communications	Oral, written, visual, mechanical signaling	Content is communicated orally, in writing, and visually within seconds worldwide
Timing of communications	Usually synchronous	Usually asynchronous
Movement of goods	Actual movement	Movement can be initiated and controlled in virtual space
Movement of people	Actual movement	Movement can be planned, monitored and coordinated
Movement of information	Actual physical information moves from days to seconds worldwide	Virtual information moves within seconds worldwide
E-commerce	Value chain and supply chain of goods influenced by geography	Provides information flows that increase the efficiency and productivity of value chains and supply chains
Delivery of services	Service delivery needs geographic presence, reflects cultural norms and contemporary social practices	Service delivery can be nearly instantaneous, reflects cultural norms and contemporary social practices
Audience	Up to hundreds of thousands or millions	Up to the whole connected world in the multi billions

while Aoyama and Sheppard (2003) emphasize the interdependencies between physical and virtual space. The two types of space are quite different—content of physical space is both physical (e.g., a book) and informational (e.g., contents of the book), whereas virtual space is informational (Kellerman, 2002; Aoyama and Sheppard, 2003). They differ in the speed of movement. Whereas traditional communications depended on transport, Internet communications move at the speed of light, so messages cross the globe in seconds. The differences are important because virtual space gets away from the coordinate systems and maps that geographers are used to, but often influences the city to a greater extent than do traditional location-based entities. Other differences are in collaborative structure; movement of people, information, and goods; and e-commerce and delivery of services (Romano, Pick, & Roztocki, 2010; Kellerman, 2002; Aoyama & Sheppard, 2003). Key differences in virtual and physical spaces are summarized in Table 11.5.

There is unevenness in technology levels between cities and between urban and rural areas, as well as between nations and world regions. For the world's two most populous nations, China has higher technology levels than does India on nearly all the dimensions seen in Table 11.6. China's much higher proportion of urban population contributes to this, as does its government's concerted investment in ICT over the past 10 years. China's most

TABLE 11.6 Technology Comparisons of Major Nations, Sub-Saharan Africa, and World, 2006

Nation	Pop.	Percent Urban	Percent Households with TV	Internet Users/100	Broadband Subscribers/ 100	Int'l Internet Bandwidth (bits/capita)	ICT Expenditures/ Capita (US dollars)
India	1,110	29	32	5.5	0.21	24	50
China	1,312	41	89	10.4	3.88	196	108
Hong Kong, China	7	100	99	55.0	20.20	13,439	2,428
United States	299	81	99	69.5	19.42	3,307	3,846
Sub-Saharan Africa	782	28	14	3.8	0.03	5	NA
World	6,538	49	83	21.4	5.46	529	564

NA = not available

Source: World Bank, 2007.

advanced cities, such as Hong Kong, Beijing, and Shanghai, have technology levels equal to or approaching those of developed nations. Hong Kong, which is 100 percent urban, ranks along with the top 10 nations on most indicators, as seen by its comparability to the United States. This is balanced by China's western provinces, which are highly rural and have very low technology usage.

India has developed into a world outsourcing technology leader. Cities such as Bangalore, Mumbai, and Chennai have developed zones of world-class ICT importance. However, these technology islands are more than balanced by India's huge village system, which accounts for most of its 788 million rural people. This urban-rural disparity is evident when comparing urban and rural areas on the basis of the number of telephone subscribers per 100 persons, referred to as teledensity. This includes both mobile and fixed phones. A huge urban-rural gap is evident and has persisted for a decade. Even though all teledensities are rapidly growing, the gap persists (see Table 11.7). The problem is that the central government and private investors have tended to ignore the remote and very poor parts of the country. At the other extreme is Bangalore, home to world-class Indian and foreign technology companies, specialized high-tech zones such as the Electronic City, pools of the finest young

TABLE 11.7 Urban and rural teledensity for India.

Urban and rural teledensity (fixed and mobile) in India, 1998–2009

Year	Urban Teledensity	Rural Teledensity
1998	5.78	0.43
1999	6.87	0.52
2000	8.23	0.68
2001	10.37	0.93
2002	12.21	1.21
2003	14.32	1.49
2004	20.79	1.55
2005	26.20	1.74
2006	—	—
2007	52.00	6.00
2008	—	—
2009	88.66	14.80
2010	128.20	26.43

Sources: TRAI. (2005). "Study paper on indicators of telecom growth." Study paper No. 2/2005. New Delhi, India: Author; TRAI. (2007, 2009, 2010). "Indian telecom performance services indicators." Author. "Urban and rural teledensity," p. 5.

FIGURE 11.15 New hires at InfoSys's Global Training Center near Bangalore, India.

workers in India, and major financing. For instance, in 25 years Infosys has grown from a small Bangalore firm with several employees to a global technology outsourcing giant with over 100,000 workers headquartered in Bangalore's Electronic City area. Figure 11.15 shows engineering graduates recently hired by Infosys who are being trained at Infosys's global training center near Bangalore. Critics have claimed the government neglects impoverished neighborhoods nearby (Graham, 2002).

Cities in the United States similarly show unevenness in ICT intensity. For instance, San Jose (hosting the Silicon Valley), Seattle, Los Angeles, Boston, and Atlanta are known technology leaders, while older industrial cities such as Detroit languish. On a global basis, nations and regions have extreme variations; largely rural sub-Saharan Africa has a minimal level of ICT. As seen in Table 11.7 the region had only 3.8 Internet users per 100 people and only 1 broadband subscriber per 3,300 persons in 2006.

Since technology and the Internet can benefit cities and their economies, businesses, and residents, this section gives examples of technologies in cities such as telecommuting and mobile Internet devices and provides some explanation of why certain urban areas have cyber-flourished while others have been passed by. These examples demonstrate the impact of ICT. Consider that fixed public phones are being removed or ignored, while the rapid increase in mobile Internet phones influences people's schedules, commerce, communication, leisure, and behavior. Millions of accessible websites supplement city dwellers' information about the urban environment and its occupants, sense of space, activities, and economic exchanges. At the same time, a city's built infrastructure, economy, and educational level support an appropriate level of technology use that can be achieved.

The lessons regarding technology in cities are several. From Chapter 8, there are often strong traditional geographic reasons for similar types of companies and institutions to agglomerate. This helps to account for why so much Internet production and consumption are located in certain cities that also lead in related information industries such as technology, advertising, media, research and development, and education. There is a difference today, however, in that these lead cities are less self-contained, but have huge cross-flows of information going out and coming in through virtual space regionally and worldwide. Because of increasing environmental and traffic concerns and the growing size of cities, telecommuting will grow as an important form of employment. Another lesson is that urban geography will need to consider new connectivity between urban people that is more virtually connected than physically, yet retains some physical aspects.

11.11.2 Telecommuting

Because medium-sized cities, large-sized cities, and megacities have traffic problems and congestion, it is becoming increasingly difficult for large numbers of commuters to move through a metropolitan area on a daily basis. This is one of the justifications for edge cities (see Chapter 10). Alternatively, settlement patterns can "scatter" into urban fringe developments (Chapter 10).

Telecommuting, or the practice of allowing employees to arrange for work at home or sites other than their corporate office, has been an issue of ongoing interest to researchers and practitioners (Haddon & Brynin, 2005; Hjorthol, 2006; Moos & Skaburskis, 2007; Nilles, Carlson, Gray, & Hanneman, 1976; Ory & Mokhtarian, 2006; Vega, 2003). Many factors have contributed to keeping this issue current, and often controversial. Initially, telecommuting was thought of as an alternative to reduce traffic congestion and pollution in large cities by eliminating the need for employees to commute between their home and their offices (Nilles et al., 1976; Vega, 2003). Later on, organizations realized its potential for cost reduction by eliminating need for office space (Apgar, 1998). Some also noted productivity increases because of elimination of work distraction and commuting time for employees (Navarrete & Pick, 2003). Highly skilled individuals realized the personal gains of engaging in this working arrangement (e.g., autonomy, financial savings, and reduced stress). Some demanded a telecommuting arrangement as a condition for employment. For these reasons, telecommuting grew, and telecommuters now compose about 10 percent of the labor force in advanced economies (Moos & Skaburskis, 2007).

In a metropolitan area, a business may be headquartered in the downtown, but it may also have its headquarters in the suburbs or at the fringe. Hence, the teleworker might be close to the city center, but at some distance from his or her employer (Moos & Skaburskis, 2007). The motivations and causes of telecommuting vary. Some employees—such as insurance agents, consultants, and field workers—are naturally mobile, so telecommuting frees up their time. For others, telecommuting enables better synchronization of work and home activities. Some seek a lifestyle change, which traditionally was to escape the central city, but today for young, educated professionals might be to return to the center as gentrifiers (Moos & Skaburskis, 2007). In other instances, city and regional agencies encourage telecommuting to reduce traffic, congestion, pollution, and emission of greenhouse gases.

A study of three Canadian cities—Toronto, Montreal, and Vancouver—showed there was not one pattern and explanation of telework, but several (Moos & Skaburskis, 2007). The three cities were consistent overall in their patterns. Teleworker locations were measured by the location quotients of census tracts for telework. For Toronto, seen in Figure 11.16, telecommuters' homes with location quotients (LQs) of 1.5 or more tended to be located along a 15-mile axis extending north from the edge of the downtown. A few were in northern fringe areas 20–45 miles from the downtown, while others were in affluent areas 14 or more miles to the southwest along the shoreline of Lake Ontario. The study indicated five explanations for this distribution (Moos & Skaburskis, 2007):

1. Teleworkers seek more amenities and larger homes on the periphery.
2. Highly educated and smaller telework households prefer gentrified locations in the central city.
3. High-income teleworkers in cultural, arts, entertainment, and financial services seek central locations near clients, specialized services, and amenities.
4. Poor households are drawn to inner-city areas with inexpensive, low-quality housing.
5. Some telework households, often dual worker, have high turnover in jobs due to economic restructuring and chronic job change.

The overall conclusion is that teleworkers seek flexibility suitable to their varied occupations, lifecycle stages, and lifestyles.

A somewhat similar telework pattern was evident in Norway's three largest cities of Oslo, Bergen, and Trondheim

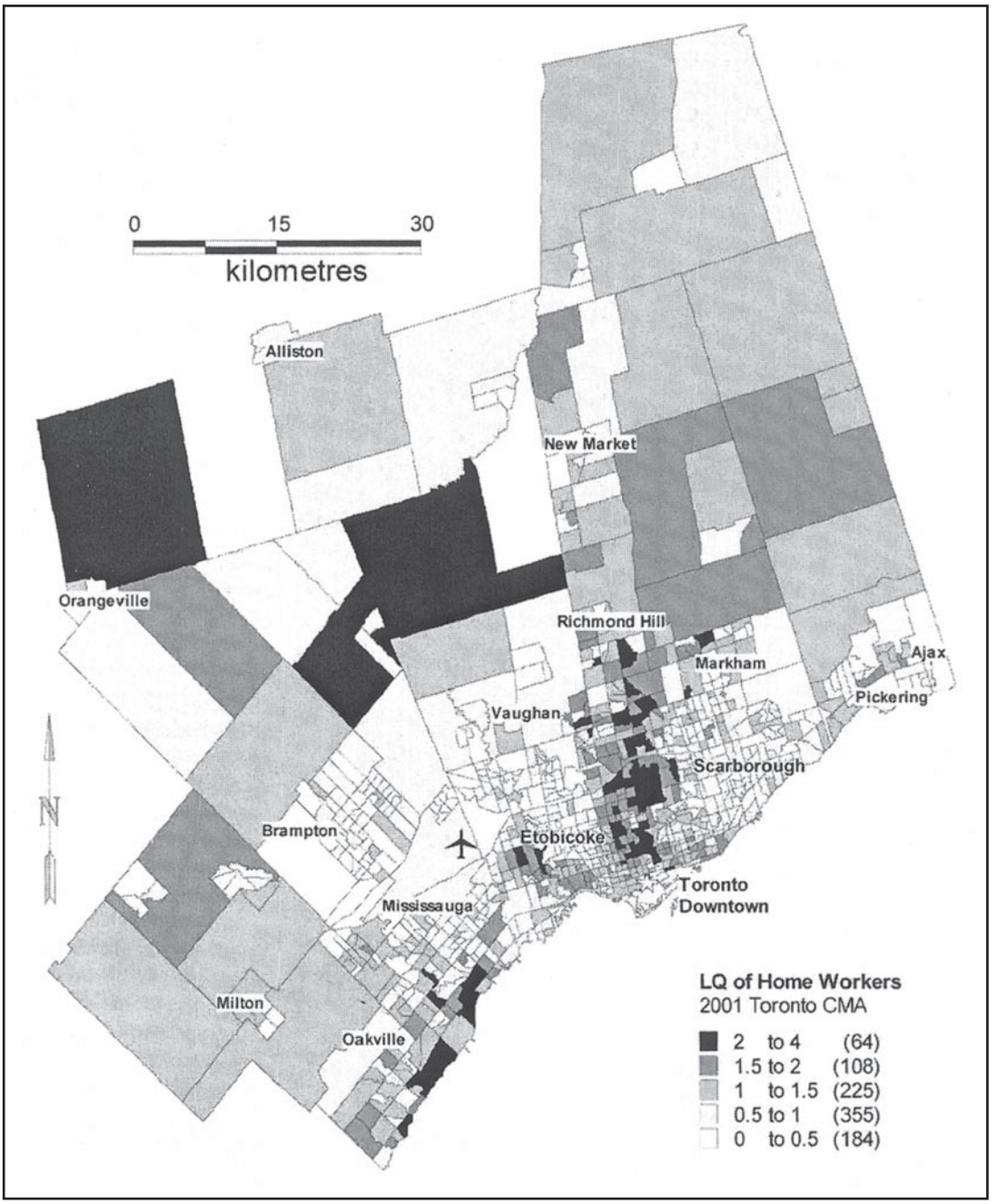


FIGURE 11.16 Location quotients for distribution of teleworkers in the Toronto Combined Metropolitan Area, 2001. *Source:* Moos, Markus and Andrejs Skaburskis. 2007. "The Characteristics and Location of Home Workers In Montreal, Toronto and Vancouver." URBAN STUDIES 44(9):1781–1808. Copyright © 2007, Urban Studies Journal Limited. Reprinted by Permission of SAGE. Figure 7. P. 1801.

(Hjorthol, 2006). In a random sample of residents, only 8 percent of working days involved telework. Telework was more prevalent for professionals, for business owners, and for males, especially those with higher education and income. The teleworkers resided in both central and dispersed locations. Telework was seen to fit in with new, flexible, shorter-duration arrangements of work more prevalent for younger workers. As with the Canadian study, centralizing and decentralizing tendencies were seen. In a few intensive interviews, teleworkers pointed to their motivation to reduce the "squeeze" of trying to satisfy work and home demands by eliminating commuting time and increasing flexibility (Hjorthol, 2006).

The benefits of telecommuting are varied for diverse individuals and organizations. There have also been reports of behavioral problems from this alternative work arrangement for individuals and organizations. They include workers' feelings of isolation by staying away from the office, work–family conflicts due to the inability to separate work and family issues, and management's inability to deal with the new mechanisms for controlling and evaluating employees. Similarly, other reports find evidence of a decline in productivity among telecommuters because of their lack of commitment to the organization or to their increasing levels of stress brought about by working at home. These adverse outcomes have kept many

businesses and individuals from adopting telecommuting (Vega, 2003).

There are urban planning lessons here. First, telecommuting can benefit a city by reduced traffic congestion and environmental deterioration, including greenhouse gas emissions. Second, a basic motivation for telecommuting is that many employees like to work at home. While the traditional view has been that the more distant the commuter is from the workplace, the more likely he or she will be motivated to telecommute, some studies show the opposite: that the decision to telecommute determines commuting distance (Ory & Mokhtarian, 2006). While telework productivity gains have been noted, also evident are losses to the vitality of businesses and organizations. The distance from the workplace might lead to lowered morale and work motivation. The employee's career might suffer from his or her lack of visibility to peers and managers (Zigurs & Qureshi, 2001).

11.11.3 Mobile Spatial Connectivity

Mobile phones have grown worldwide to total over 4 billion. The mobile phone now is the standard and is displacing the fixed phone. Many mobile phones are internet-connected, which serves to vastly widen Internet access. Other portable devices such as lightweight notebooks, tablet PCs, iPads, and portable global positioning system (GPS) devices add to this connectivity. This dimension of technology is a new one for urban geography. Much opportunity exists both for city and regional planners and researchers to understand and set policies and actions related to it. Mobile technology enables urban workers and residents to utilize information, make decisions, and communicate any time, any place. Hence, the rootedness of place in the city is being altered. Business decisions can be effected on the move, rather than in downtown conference rooms. People can stay in constant communications without being in proximity. Very large databases are accessible to sales teams at customer sites, to utility workers repairing pipelines, and to public safety workers in city emergencies.

Mobile technologies potentially can provide Internet connectedness to enlarged realms of urban residents, including disadvantaged minorities. Internet-capable mobile phones are increasingly user-friendly and reasonably priced. In Japan, Internet mobile phone use has leapfrogged beyond fixed computer access to the Internet (Akiyoshi & Ono, 2008). In 2008, there were 97 million Japanese subscriptions to mobile phone services; that was three-quarters of the population, which is four-fifths urban (ITU, 2009). Japan has lagged behind in computer access to the Internet, which has particularly reduced access for women and for poorer and less educated people due to high costs, difficulty with the English language, and limited keyboard skills. However, Japanese mobile phone providers understood these issues and emphasized ease of use and a Japanese language interface. For the mobile Internet in Japan, most prior socioeconomic barriers such as education and income have fallen away, although older age remains associated with reduced use (Akiyoshi & Ono, 2008). A factor of concern is that the mobile devices are constrained by small screen size and speed, so full computer-based capabilities are constrained (Akiyoshi & Ono, 2008). However, overall the burst in adoption of mobile Internet phones has raised the urban connectivity within and between Japanese cities and has made more widespread its many Internet and mobile advantages and opportunities. As mobile technologies become ubiquitous and powerful, urban planners will need to take greater account of them in designing government programs, supporting mobile infrastructure, and understanding how urban place is affected by mobile information flows.

11.11.4 The Urban Digital Divide

Cities are uneven in their use of technology, both within single cities and between groups of cities (Graham, 2002). This unevenness is referred to as the *digital divide*. An example is the San Francisco Bay Area, which has intensive Internet use in the Silicon Valley at its southern flank, in its heavily wired downtown area, and in its university communities such as Berkeley and Stanford. However, Internet use remains very low in disadvantaged parts of the metropolitan area, such as parts of Oakland. Referring to Atlanta, there are locations of high Internet bandwidth in medical and technology business clusters and edge cities located to the north of the downtown (Georgia Power Company, cited in Walcott & Wheeler, 2001), but other disadvantaged areas to the south have low levels of Internet connectivity. The differences in technology levels occur also at the county level in the United States, with urban counties tending to have higher levels of technology, which are associated with higher levels of education, research and development, and a technical/professional workforce (Azari & Pick, 2003, 2005). Global megacities of the developing world typically have zones with "super-connected" people and businesses, which, however, closely adjoin areas of minimal or no technology use. The cycle of poverty can keep ghetto residents in place and unable to adopt new technologies.

Government planners can set urban policies that will seek to offset these disparities (Graham, 2002; Schwanen, Dijst, and Kwan, 2006). They include providing digital infrastructure, extending access to the web, encouraging the spread of wireless Internet, implementing direct public and nonprofit interventions to help the technology disadvantaged, and supporting more local control over the content of the Internet and ICTs. An example in the United States is the Obama administration's Promise Neighborhoods program, which includes technology skills training. Cities such as Philadelphia are providing government-sponsored broadband, wireless services to all constituencies. In the southern Indian state of Tamil Nadu, the local language of Tamil is being emphasized for ICT content. It is likely that urban and regional planning in the future will give more attention to enhancing the growing ICT and the virtual dimensions of the city.

An example of a city influenced by technology is Bangalore, India, often referred to as India's Silicon Valley. It is a world center for programming and software development. Entrepreneurs and scientists have accumulated wealth from this high-tech boom, but at the same time, the city has "an extremely fragmented and polarized urban structure" (Graham, 2002, p. 45). At the high end is the Electronic City area of several hundred acres containing world-class facilities of Texas Instruments, IBM, Motorola, and lead Indian tech firms such as Infosys and Wipro, which services computers globally (Graham, 2002). Other parts of the city are impoverished and entirely cut off from the high-tech centers.

This brief example raises the issue of the urban digital divide. Cities are beginning to grapple with and address it, but many of them have other pressing problems that often push the divide aside in priority. It remains important because of the rapid growth of technology and its impact on the workplace.

11.12 PLANNING CHALLENGES IN THE DEVELOPING WORLD

The last section of this chapter considers planning practices and experiences in developing nations. Do the approaches to planning of developing nations differ from those of advanced countries, or are they similar? How do the results compare? What are the constraints on achieving good planning outcomes anywhere in the world?

11.12.1 Planning Mexico's Cities

In Mexico, there is a history of urban planning over many centuries. The ancient civilizations of the Mayans and the Aztecs built advanced cities and urban designs for their time. The Spanish colonial settlers in the 16th century originally rebuilt Mexico City with a careful design modeled on Spanish cities of the era. When the French ruled Mexico for several years in the 1860s, French architects contributed the grand Paseo de la Reforma, modeled after the Champs-Elysees in Paris.

With this impressive history, it is disappointing that planning for Mexican cities today has become a very political process (Herzog, 1990; Ward, 1998). This is explained by the government structure in Mexico, which has at the top a financially well-endowed federal government, below it weaker state governments, and below that much weaker municipal governments (Herzog, 1990). Although these disparities were somewhat reduced in the mid-1990s by federal legislative changes in the revenue-sharing formulas affecting the three government levels, they remain largely in place. The result is that local and regional governments have a limited potential to accomplish planning.

In fact, until the 1970s, there was almost no formal local planning in Mexico (Herzog, 1990). It was only in 1976 that the Mexican government recognized local planning prerogatives. However, the results for cities and *municipios* have been weak (Butler, Pick, & Hettrick, 2001; Ganster & Lorey, 2008; Herzog, 1990; Romero/Lar, 2008). Local government planning is limited to the construction of small public works and some water and energy services, while the federal government plans the national economy, public housing, tourism, street and road construction, energy, and environmental controls. States provide much of the primary and secondary education and local economic development. Uneven planning for housing in Tijuana, Mexico, is shown in Figure 11.17.

At the local level, there are conflicts of interest, efforts to please political constituencies, and some mishandling of funds (Herzog, 1990; Romero/Lar, 2008). Of course, such practices are not unknown in the United States and European countries, but they are relatively more prevalent in Mexico.

Several large Mexican border cities—notably Ciudad Juarez—have formed quasi-government metropolitan planning agencies. The border challenges for planning include overcoming deficits and problems of infrastructure, severe crime, in security,

FIGURE 11.17 Weak planning in Tijuana, Mexico.

public health, drug trafficking, transportation, water, energy, environmental pollution, and education (Ganster & Lorey, 2008; Romero/Lar, 2008). In the case of Ciudad Juarez, Mexico's sixth-largest city, the planning agency is known as *Instituto Municipal de Investigación y Planeación* (IMIP). Its charter is to formulate, realize, and evaluate the Urban General Plan and its parts, zoning rules, and other urban standards so as to ensure congruence with the *municipio,* state, and national plans of urban growth (IMIP, 2010). The agency has nearly 100 employees, only some of whom are planning professionals. IMIP has adopted GIS and makes large databases available to the community. It also has orientation and diffusion initiatives to inform the people about its programs and to improve the public welfare. It has a large office, library, bookstore, and server-based information system with GIS. In essence, this sounds like an up-to-date American metropolitan planning unit. So far, however, the impact of IMIP has been mixed. Some major infrastructure deficits have not yet been remedied—not because of lack of planning, but because of the city's severe crime and security crisis, the scarcity of municipal funding, political roadblocks.

The challenge for Mexico in the future is to further professionalize its municipal planning; provide teeth to it through enforcement and better legal recourse; improve the funding of municipal planning offices and bodies such as IMIP; reduce political corruption of the planning process; learn from, but not necessarily imitate, the planning knowledge and methods from the United States and other advanced nations; and educate the local electorate and business community about modern urban planning.

There is not sufficient space in this text to cover the many other nations doing urban planning comprehensively, but several other examples are worth noting (Sanyal, 2005). The Scandinavian nations have had strong urban planning, often combined with architecture and urban design. Their cities tend to be well arranged, environmentally friendly, and not overrun with growth problems. Singapore is a noteworthy success in instituting high-speed Internet throughout the entire city-state and has set information technology deployment as a high-priority goal (Infocomm Development Authority of Singapore, 2006; Wong, 2003). There are concerns, however, about too much government intrusiveness and tight control of the Internet platform (Wong, 2003).

11.12.2 Shanghai: Planning a Global Megacity

Finally in China, the megacity of Shanghai has remarkably increased its modernity in a space of only about 15 years, with much more ambitious plans in the future to reinforce its role as a leading global city (Wujun & Xiang, 2007; Yusuf & Wu, 2002). Shanghai is China's largest city, with a metropolitan area population in 2003 of 16.6 million (Forstall, Greene, & Pick, 2009).

FIGURE 11.18 Pudong District of Shanghai, China. Photo by J. Pick.

The municipal government committed itself to growth planning through sheer will in setting ambitious strategic objectives and not wavering. In the process, its city leadership has become rather more autonomous from the Chinese central government (Yang & Chang, 2007; Yusuf & Wu, 2002).

The following are some examples of Shanghai's accomplishments in planning, strategy, and implementation since 1999 (Wujun & Xiang, 2007; Yang & Chang, 2007; Yusef & Wu, 2002):

- The new Shanghai international airport opened in 1999.
- The huge Economic and Technology Development Zone (ETDZ) of Pudong, across the Huangpu River from the historic center, has grown to become the largest free-trade zone in China, with hundreds of new businesses and China's tallest buildings, including 100+-story skyscrapers, as seen in Figure 11.18.
- Three bridges and two tunnels have been built across the Huangpu River, as well as expressways, a ring road, and two new subway lines.
- Public utilities have been given greater management autonomy.
- The Shanghai World Expo of 2010 was planned and constructed. This was the largest expo ever held in China and further opened up Shanghai's accomplishments to the world.
- Concern for historical preservation has been built into the city's master plan. Some historical areas, such as Xintiandi, have been preserved in spite of rampant development (Yang & Chang, 2007).
- Millions of residents have been forced by the massive developments to relocate, with much criticism. However, in an extensive survey of Shanghai's inner core and suburbs, those evicted indicated their subsequent housing conditions are somewhat better than average for the urban area (Li & Song, 2009).

A brief example illustrates the city's planning dilemmas. Since land prices have risen in the business core of Shanghai, including the French Quarter and Pudong, to among the world's highest, urban redevelopment in the center is challenging. For the Xintiandi area, on the edge of the central city and seen in Figure 11.19, a long-term coalition between government and private companies was able to succeed in a pro-growth way. The Luwan district encompassed the French Concession, a tiny area stemming from foreign influences a century earlier, as well as Xintiandi, an area in the center that was old and deteriorated, inhabited by lower- and middle-class Chinese. This area consisted of winding lanes with old buildings in the traditional Shikumen architecture. It also included the building that hosted the first session of the National People's Congress at the birth of the People's Republic of China. As it turned out, the development proceeded successfully with participants that included the city and district governments, lead developer Shui On Group from Hong Kong, foreign investors from Europe and Asia,

FIGURE 11.19 Street in Xintiandi Redeveloped Zone of Shanghai, China. Photo by J. Pick.

design and planning firms, organizations for removal and relocation, and universities (Li & Song, 2009). The shops in Xintiandi have skyrocketed in value and rentals. This halo has spread to surrounding neighborhoods, which have seen new developments and rising prices. On the other hand, residents have faced the difficult choice of staying in a now nearly unaffordable area or moving away from their traditional favored location to peripheral locations for which rental costs have also risen. The city and district were pleased at achieving some historical preservation and found the coalition's growth-oriented approach satisfactory. This example highlights both how far contemporary Shanghai has risen and how important the new planning challenges of maintaining affordability and preserving history and identity are.

Perhaps the biggest remaining problem in transforming Shanghai into a global city is the lack of adequate skilled labor. This point goes back to rural-to-urban migration and the Chinese residence registration system, as discussed in Chapter 6. The challenge is not only reducing the residency strictures, but also training Shanghai natives as well as immigrants to join the highly skilled workforce that is being called on to further build and develop the new Shanghai global city.

Summary

This final chapter covered the planning of cities. There is a long and often successful history of planning. In the United States, major recent development approaches have been metropolitan and regional planning, growth management, and smart growth. It is important to understand and appreciate planning as a means to revitalize downtowns, advance green initiatives, and achieve urban open space.

Technology is changing the flows of people and information in cities. The Internet, telecommuting, and mobile devices are examples of work modes that influence work, transportation, communications, physical, and organization environments. Many case examples were discussed in the chapter, including the classical zoning and growth debates in New York City, Ramapo, and Petaluma; mixed planning in Irvine; planning in Shanghai; and technology in Canada and Japan.

The chapter brought together concepts and methods from the other chapters, stressing that planning is multidimensional and integrative. In concluding, we would like to emphasize the importance of studying urban geography. The world's urban population is continuing to increase rapidly, and the number of large metropolitan areas is growing even more. A geographic perspective is essential to understanding, analyzing, planning, and effecting actions and changes to improve cities. The effectiveness of learning and applying urban geography is enhanced by use of modern technology tools like GIS, which is uniquely suited to capturing the many spatial layers and dimensions of the contemporary city and providing analytic tools to model its growth and change.

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Exercise

Exercise Description

Modeling functions in a GIS through the analysis of population growth impacts in an urban fringe watershed.

Background Information

Introduction: The Blackberry Creek watershed is located on the western fringe of Aurora in Kane County, Illinois. Kane County itself is located on the western fringe of the Chicago metropolitan area and in recent years has experienced tremendous growth and development. According to the U.S. Census Bureau's population estimates, the county added 86,648 persons from 1990 to 2000 (a 27 percent increase), which places it among the fastest-growing counties in the state.

A telecommunications company, Gpsnet (fictitious), recently announced that it would locate a very large cellular phone plant in the vicinity of Prestbury, Illinois, and Sugar Grove, Illinois, both of which are within the watershed. Gpsnet's announcement was a disappointment not only to economic development officials in Aurora, who had tried to lure them to a brownfield site in the city, but also to regional planners, who had been discouraging additional sprawl within the metropolitan region. The decision also stirred the emotions of farmland preservationists, who contended that the population growth associated with the new plant would reduce the rural character of the watershed.

In this project, you need to assess the impact of the new plant on the watershed's resource base and on the growth of the watershed's population to the year 2020.

Impact of the New Plant on the Watershed's Population to the Year 2020: We are going to use a simple exponential population forecast model (Krueckeberg & Silvers, 1974). The following formula is used for calculating a growth rate over a given period:

$$P_{t+n} = P_t\,(1 + r)^n$$

where

$$r = \frac{1}{m}\sum_{t=2}^{d}\frac{P_t - P_{t-1}}{P_{t-1}} = \textit{Growth Rate}$$

P = Population
t = a time index (years)
P_{t+n} = population (n) units of time from (t)
n = number of units of time (in years)
m = number of historical intervals over which average is calculated
d = the date of the latest data being analyzed

Using the following population estimates for Kane County from the U.S. Census Bureau illustrates the calculation procedure:

Population Estimates

1994	1995	1996	1997	1998	1999	2000
346,687	356,995	366,912	367,725	386,103	396,371	404,119

Growth rates

1994–1995	1995–1996	1996–1997	1997–1998	1998–1999	1999–2000	Average
.029	.028	.027	.025	.026	.019	.025

$$\text{Pop2020} = \text{2000Pop}*(1 + \text{growth rate})^{20}$$
$$\text{Pop2020} = 404{,}119*1.638616$$
$$\text{Pop2020} = 662{,}755$$

This example derives a base growth rate (1.64); however, a given area within the county can experience a different growth rate based on a number of characteristics. In this project, we assume that the following conditions will influence a block's growth rate:

- ***Distance to Proposed Plant Location:*** An obvious condition would be proximity to the proposed plant. We assume that workers will want to live close to the new plant, so that they can get to work quickly. Therefore, parcels within one-half mile will receive a higher growth rate.

  Growth rate plus a factor of 1.2
- ***Distance to Major Road:*** Until the road network improves during this rapid development period, developable land adjacent to major roads leading to the plant will experience faster rates of growth. Parcels within one-half mile of these major roads will receive a higher growth rate.

  Growth rate plus a factor of 1.0
- ***Existing Land Use:*** The current use of the land will dictate what is available for future growth. Thus, vacant and agricultural land will be able to accommodate the most people. Agricultural and vacant areas will grow at a high rate, whereas parcels composed of residential land will grow at a moderate rate. The movement to protect environmentally sensitive lands will result in a low growth rate for these areas.

  Agriculture: Growth rate plus a factor of 0.8
  Low-Density Residential: Growth rate plus a factor of 0.2
  Environmentally Sensitive Lands: Growth rate minus a factor of 1.2

The values of the growth weights were determined by first establishing 4.64 (1.64 + 3.0 of additional growth) as the maximum possible growth rate for a given block within the watershed. We then allocated the additional growth among the various factors based on our assumptions about the relative importance of each in terms of ability to attract future growth. For instance, consider a block that will grow at the county rate (1.64), is within a half-mile of the proposed plant (1.2), is within a half-mile of a major road leading to the plant (1.0), and is agricultural land (0.8). Adding the growth factors for the latter block yields 4.64 (1.64 + 1.2 + 1.0 + 0.8).

Google Earth Version

1. For the Chapter 11 exercise, there are 5 separate Google Earth KMZ files, one for each phase of the growth model that is computed in the ArcGIS exercise that follows. To begin, launch the Exercise11A Google Earth KMZ file by double-clicking it:

2. The original layers for part A of the growth model included the roads and the proposed cellular phone plant location. In the GIS exercise that follows, the major roads leading to the proposed plant location are buffered by a half-mile, which is the layer shown with a yellow outline. The proposed plant location is also buffered by a half-mile, which is the layer shown with the purple circular outline. The major roads and proposed plant location were buffered by a half-mile because the assumption is that these areas will grow at a faster rate than normal because of the additional demand placed on this land by the future workers of the plant.

   The "union2" layer resulted from combining the roads buffer and the plant buffer in a GIS union procedure as well as a GIS cookie cutter procedure that removed the roads buffer that extended beyond the watershed boundary. The "union1_query" resulted from a GIS query that ensured the land in these areas could be queried out in a later step of the GIS model to compute the area growth rates. This particular query selected out land that was within a half-mile of the proposed plant and the major roads leading to the plant. The latter query was important to perform for the GIS exercise, as it allows the user to proceed to part B of the GIS model knowing that the proper growth rate calculations for these two distance assumptions will be possible in a later step. Practice turning layers on and off, one at a time, and zoom in to explore the Blackberry Creek watershed study area.

3. Close Google Earth, and launch the Exercise11B Google Earth KMZ file by double-clicking it. Turn on the "fld100" and "wetlands" layers, as these represent the 100-year floodplain and wetland areas of the watershed. A 100-year floodplain is the area of the

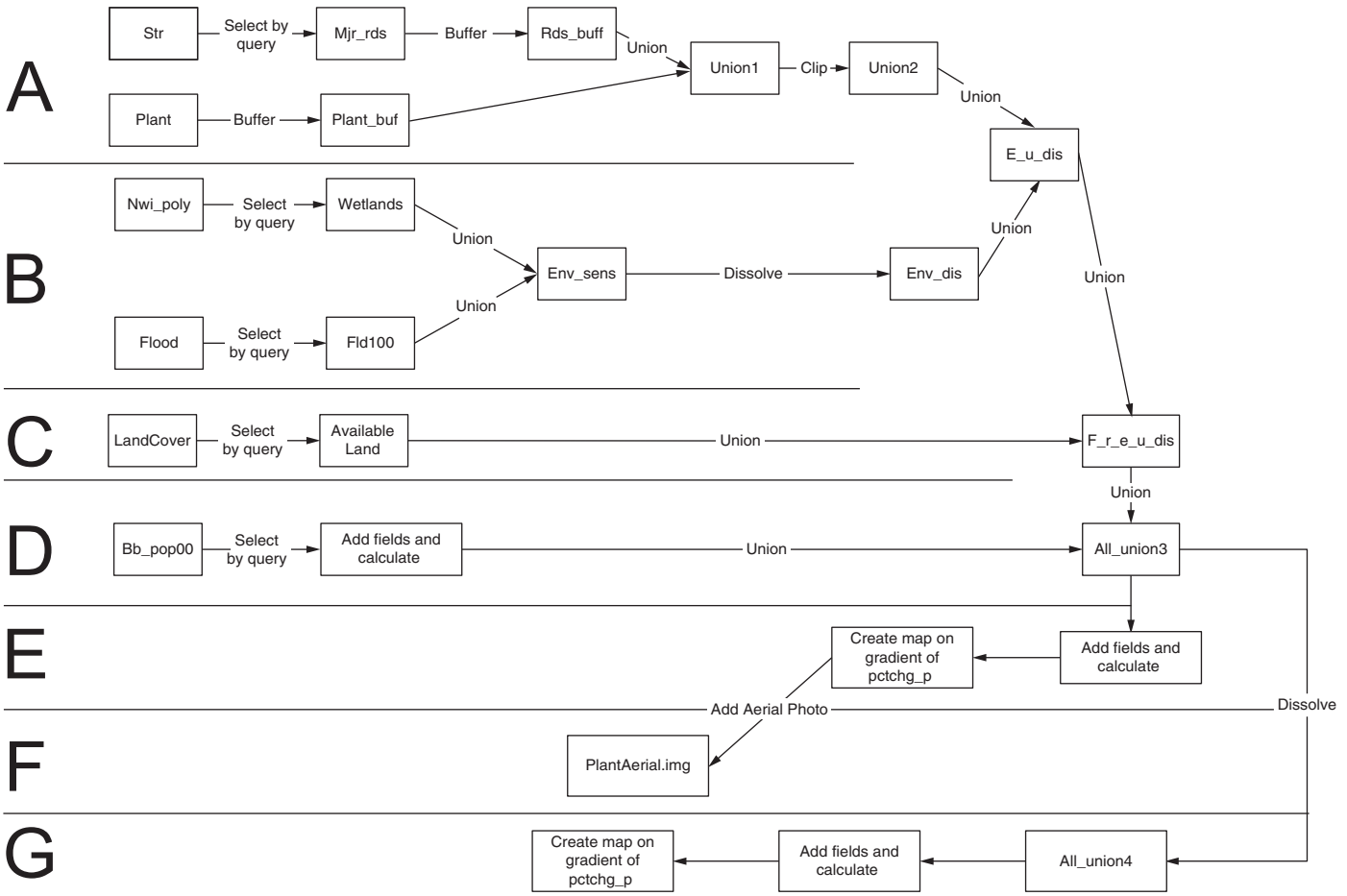
largest flooding that is predicted to take place as a rarity over a 100-year period. One of the assumptions of the model is that these environmentally sensitive lands will be protected and therefore urban development will be limited there. However, the growth model does not distinguish between wetlands and the 100-year floodplain in terms of the future growth rate, so a GIS step in part B combines the two environmental layers in a dissolve step resulting in the "env_dis" layer. Also in part B of the model, the environmentally sensitive layer is combined with the roads and plant buffers in a GIS union procedure resulting in a final layer for part B called "e_u_dis". A query at the end of part B is introduced to identify land that meets the two distance assumptions and the environmental assumptions; thus, only environmentally sensitive land within a half-mile of the proposed plant and major roads leading to the plant are shown in the "e_u_dis query" layer. Experiment with these layers by turning them on and off.

4. Close Google Earth, and launch the Exercise11C Google Earth KMZ file by double-clicking it. Available land is defined as either cropland or low-density urban land, with the assumption that both of these land-cover types have room for development. The query layer ("f_r_e_u_dis query") selected cropland that met the two earlier distance criteria and was environmentally sensitive. Zoom in to see these land segments.
5. Close Google Earth, and launch the Exercise 11D and 11E Google Earth KMZ file by double-clicking it. The file is detailed and may require more time than normal to load. Part D of the model combines population from census blocks with the other layers from the previous steps. Part E of the model shown here shows the results of the model once all of the growth rates are computed for the various assumptions. Shades of blue indicate future decline, as they are largely environmentally sensitive areas, while orange to red shades indicate future growth because of the distance criteria to the plant and major roads, but also reflect land-cover criteria such as agricultural land growth rates.

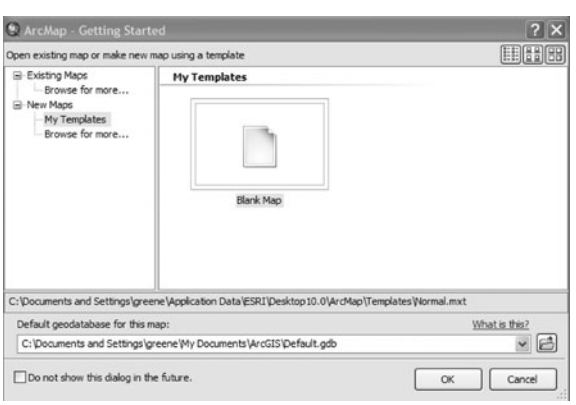
6. Close Google Earth, and launch the Exercise 11G Google Earth KMZ file by double-clicking it. Part G of the model aggregates the model results up to the census block geography, resulting in a more realistic view of future growth impacts on the watershed resulting from the proposed manufacturing plant. It is more realistic because population was originally at the block level, but during the GIS union stage, it was subdivided and reallocated to small fragments.

Google Earth Short Essay: You have experienced and examined a whole spatial modeling process that utilizes environmental, transportation, land use, and population criteria to arrive at the goal of seeing the population impacts of adding a cellular phone plant in the Blackberry Creek watershed. What is your general opinion of this spatial modeling process for planning? Do you think that the process resulted in identifying the correct areas for future population growth or not? If possible, can include maps that you can refer to in your essay.

ArcGIS 10 Version
Exercise Procedure Flow Chart



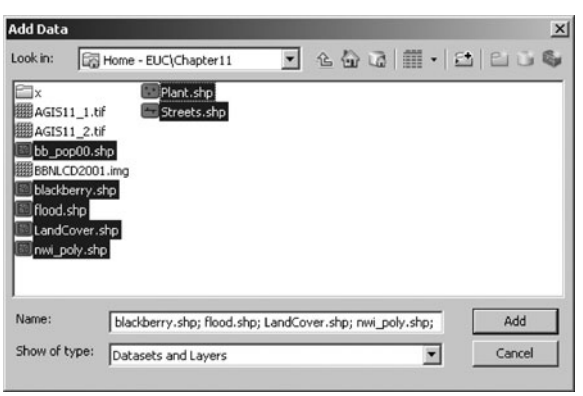
1. Start ArcMap with Start Using ArcMap With A New Empty Map selected. Click OK.



2. Click Add Data, and navigate to the exercise data folder.

Note: If you do not see the folder where you placed the exercise data, you will need to make a new connection to the root directory that holds the data.

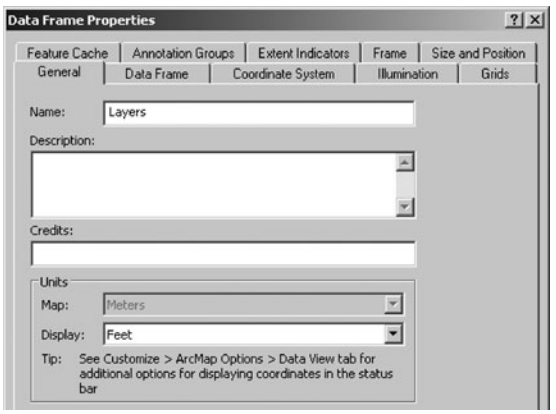
3. Add blackberry, flood, LandCover, nwi_poly, Streets, bb_pop00, and plant from the Chapter 11 folder. You can add all of these layers at once by clicking on one of the file names, then clicking the others while holding down the Ctrl key on the keyboard, and clicking Add.



4. Set the data frame properties (map units in meters and display units in feet) by right-clicking on Layers and then selecting Properties on the shortcut menu. Click the General tab, and

under Units, change the Display setting to Feet. Click Apply, and then click OK.

The following steps correspond to the flowchart that has been prepared to show the steps involved in determining the impact of the



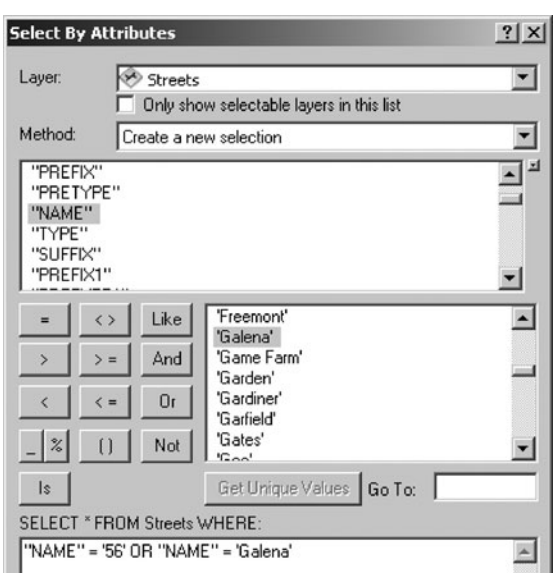
new plant on the population growth and distribution of the Blackberry Creek watershed (see flowchart above).

A. Define Major Roads and Plant Buffers

Because proximity to the plant and major roads affects the population growth, we are setting buffers to define their area of influence.

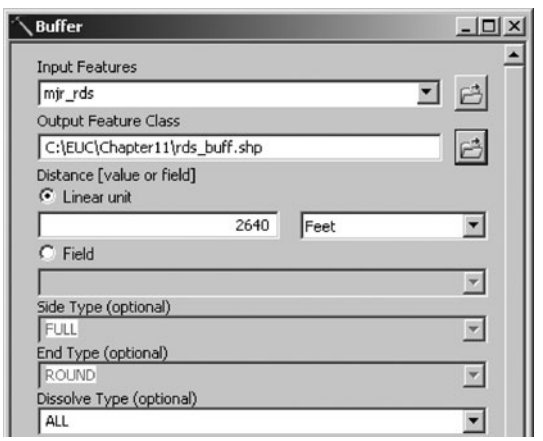
1. The manufacturing plant will be located next to the intersection of Route 56 and Galena Boulevard. Select these major roads from the Streets layer:
   - **a.** Click Selection on the menu bar.
   - **b.** Select Select By Attributes.
   - **c.** Set layer to Streets.
   - **d.** Enter the following:
   - **e.** Click Apply and OK.

"NAME" = '56' OR "NAME" = 'Galena'



- **f.** With these major roads selected, right-click Streets, and click Data and Export Data.
- **g.** Change the name from Export_Output.shp to mjr_rds.shp.
- **h.** Click Yes to add it to the map.
- **i.** Click Selection and click Clear Selected Features.

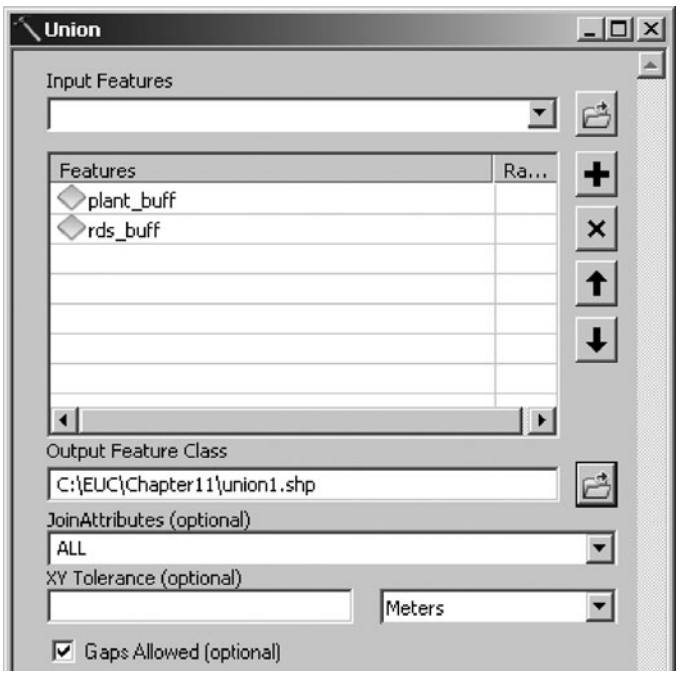
2. Buffer the mjr_rds.shp layer by a half-mile (2,640 feet):
   - **a.** Click the ArcToolBox button at the top (red button).
   - **b.** Double-click Analysis Tools, Proximity, and Buffer.
   - **c.** Fill in the Buffer dialog box with mjr_rds as the input and rds_buff as the output, set the linear unit to feet with a distance of 2640, and change Dissolve Type to All. Click OK.



We need to build memory into each of the layers that we create for the final model calculations in section E, so that we can query out each of the growth factors (i.e., within a half-mile of a major road). Thus, the following step adds a field to the new buffer and is calculated to a value of one.

3. Add a field to rds_buff.shp, and calculate it equal to 1.
   - **a.** Right-click the rds_buff.shp layer.
   - **b.** Select Open Attribute Table.
   - **c.** Click Table Options.
   - **d.** Click Add Field.
   - **e.** Set name to in_mjrd as a short integer and a precision of 0.
   - **f.** Right-click the column title of the field just added (i.e., in_mjrd), and select Field Calculator. Ignore the warning message if it appears (click Yes).
   - **g.** Enter a 1 in the large white space under in_mjrd =.
   - **h.** Click OK, and close the table.
4. Buffer the plant.shp layer by a half-mile (2,640 feet), and call the result plant_buf.shp using the same procedure as is shown in Step 2 (make sure to change the input layer name to plant and call the output layer plant_buf.shp).
5. Add a field to plant_buf.shp called plantin, and calculate it equal to 1 using the same procedure as shown in Step 3.

   We use a GIS overlay procedure known as union to combine the major roads factor and the proximity to the proposed plant into one GIS layer.
6. Union the rds_buff.shp with the plant_buf.shp to make union1.shp:
   - **a.** Click ArcToolbox, and then select Analysis Tools, Overlay, and Union.
   - **b.** Select plant_buf.shp as an input layer.
   - **c.** Select rds_buff.shp as an input layer.

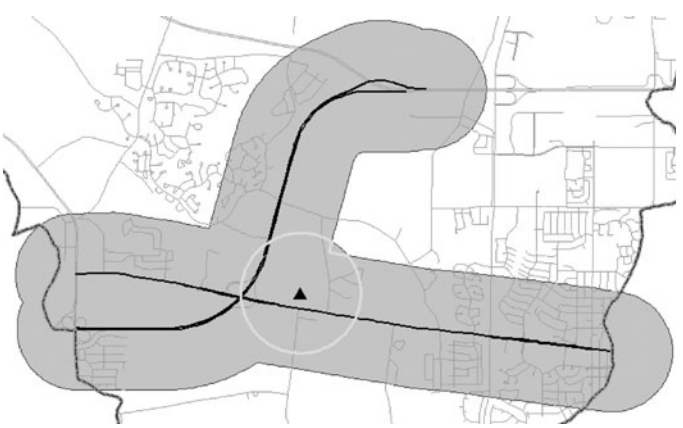


d. Name the output layer Union1.shp.
e. Set Join Attributes to All.
f. Set XY Tolerance to Meters.
g. Click OK.
h. To illustrate the usefulness of the latter step, try the following:

From the Selection menu, select Select By Attributes. Set the layer to Union1, and then enter the following expression:

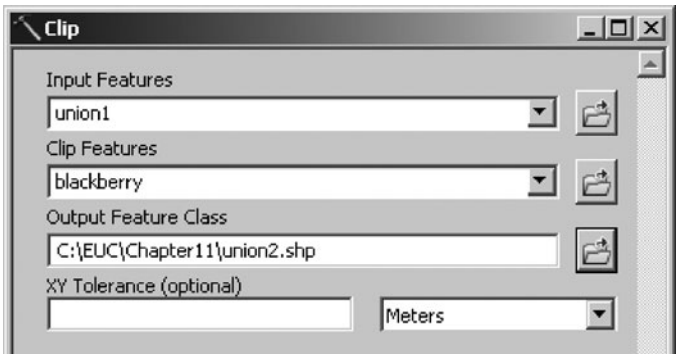
$$\text{in\_mjrd} = 1 \text{ AND plantin} = 1$$

If your previous buffers and union were correct, you should have the following polygon selected.



The new union1 layer extends beyond the watershed limits because the half-mile road buffer included the tips of the roads that intersected the watershed boundary. We use a "cookie cutter" technique known as a clip to remove the areas that extend beyond the watershed.

7. Clip the union1.shp layer by the watershed layer called blackberry.shp.
a. From the Selection menu, select Clear Selected Features.
b. Click on ArcToolbox, and then select Analysis Tools, Extract, and Clip.
c. Select Union1.shp as the Input Features.



d. Select Blackberry.shp as the Clip Features.
e. Name the Output Feature Class Union2.shp.
f. For XY Tolerance, use default Meters.
g. Click OK.
h. Right-click plant_buff, and select Remove.
i. Right-click rds_buff, and select Remove.
j. Right-click Union1, and select Remove.

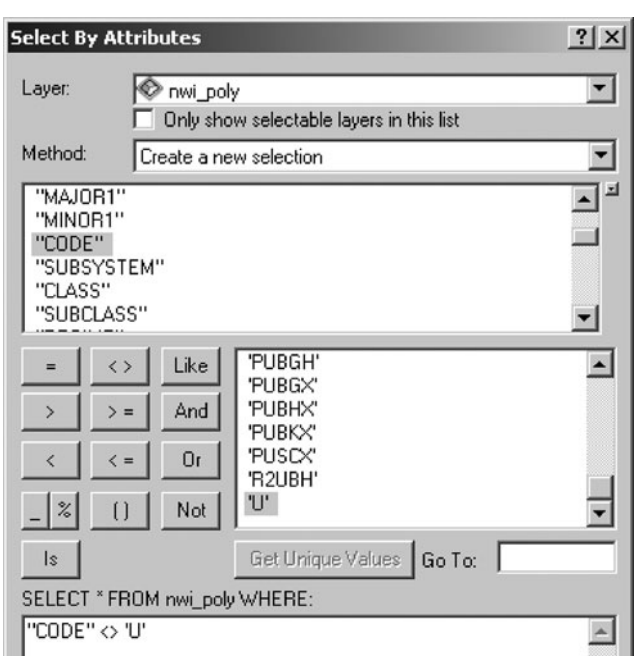
B. Make the Environmentally Sensitive Lands Layer

These next steps identify areas that are environmentally sensitive. These are defined as wetlands and those areas within the 100-year flood zone.

Our wetlands layer originates from the National Wetlands Inventory (NWI) from the U.S. Fish and Wildlife Service. These data were downloaded from http://www.fws.gov/wetlands/data/WebMapServices.html. This wetlands shapefile includes a background polygon that is a non-wetland. In the following step, we need to extract just the legitimate wetlands.

8. Extract wetlands from the nwi_poly.shp layer, and call it wetlands.shp:

Click Selection and click Select by Attributes, and enter the following query.

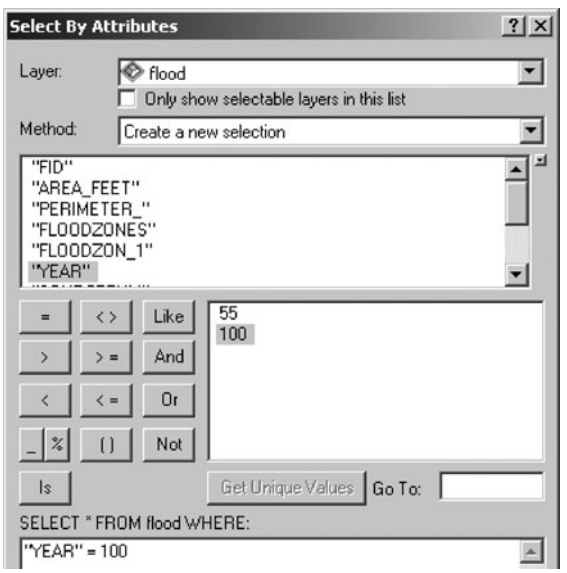


Right-click nwi_poly, select Data and Export Data, and export to a shapefile called wetlands.shp. Click Yes when asked "Do you want to add this layer to the map?" Right-click nwi_poly, and select Remove Layer.

The floodplain layer originates from the Federal Emergency Management Agency (FEMA) and includes upland areas that are surrounded by 100-year floodplains (i.e., elevated islands).

9. Extract the 100-year floodplains from the flood.shp layer, and call it fld100.shp.

Click Selection from the menu bar, and click Select By Attributes to run the following query.



Right-click flood, select Data and Export Data, and export to a shapefile called fld100.shp. Click Yes when asked "Do you want to add this layer to the map?" Right-click flood, and select Remove Layer.

10. **a.** Union the wetlands.shp layer with the fld100.shp layer to make env_sens, using the union procedure described in Step 6.

b. Remove wetlands.shp and fld100.shp.

In our model, environmentally sensitive lands are defined as either wetlands or floodplains. Thus, we can take advantage of the GIS dissolve procedure to simplify our final model layer.

11. Add a field to env_sens.shp called env, calculate it equal to 1, and dissolve:

a. Use the procedure in Step 3 to add the env field, and calculate it equal to 1.

b. Click ArcToolbox.

c. Click Data Management Tools.

d. Click Generalization, and click Dissolve.

e. Select env_sens as the Input Feature.

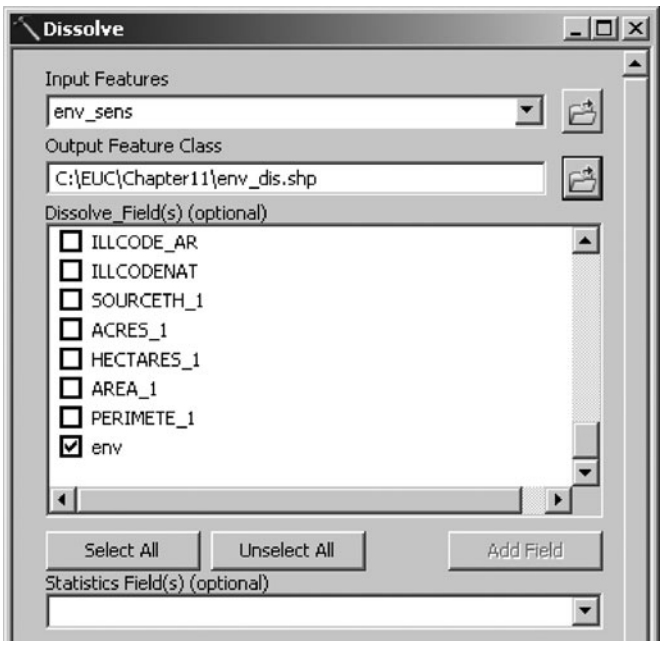
f. Name the output layer env_dis.shp.

g. Select env as the attribute to dissolve.

h. We do not use any Statistics Fields.

i. Click OK.

j. Right-click env_sens, and select Remove.



12. **a.** Union the env_dis.shp layer with the union2.shp layer to make a new layer called e_u_dis using the same union procedure shown in previous steps (refer to Step 6).

b. Right-click union2.shp, and select Remove.

c. Right-click env_dis, and select Remove.

Try the following query to see if you have succeeded in the previous steps:

Selection
Select By Attributes
make layer e_u_dis.shp
plantin = 1 AND in_mjrd = 1 AND env = 1

Question: Which types of polygons get selected?
Answer: Environmentally sensitive lands that are within a half-mile of both the plant and a major road leading to the plant.

Click the Selection menu, and Clear Selection before moving to part C.

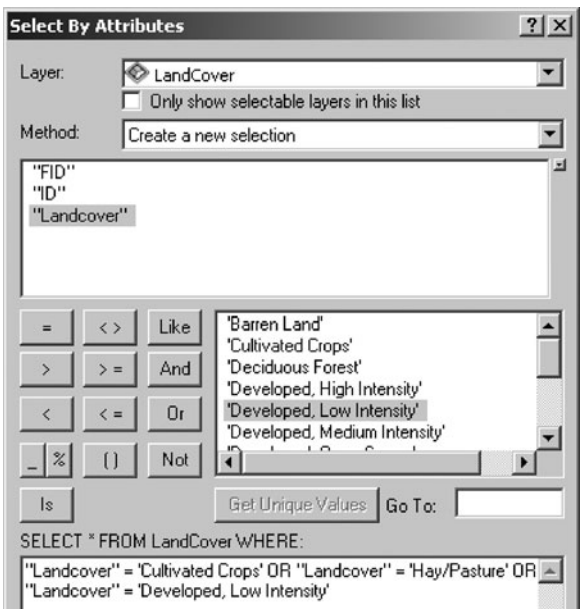
C. Make the Cropland and Low-Density Residential Layers

Our Land Cover layer originates from the 2001 National Land Cover Dataset developed by USGS and other partners. The data were downloaded from http://www.mrlc.gov/nlcd_multizone_map.php. (We clicked on Zone 11 to download a Land Cover file for the area that includes the Blackberry Creek watershed.) Once downloaded, the raster image was converted to a polygon layer and clipped to the Blackberry Creek watershed.

In our model, we want to assign different growth rates for farmland and low-density urban land, so we must now extract these categories from the Land Cover layer.

13. Extract farmland and low-density urban land from the LandCover layer, and call it AvailableLand.

Click Selection from the menu bar, click Select By Attributes, and enter the following query.

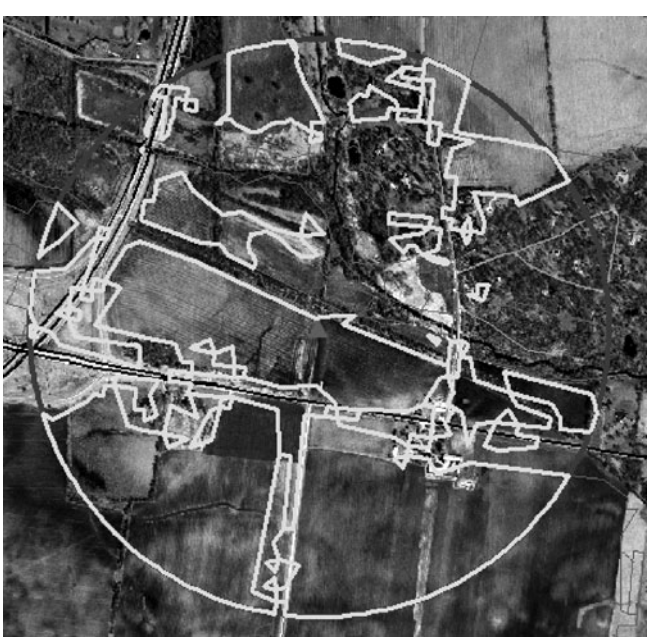


Right-click LandCover, select Data and Export Data, and export to a shapefile called AvailableLand.shp. Click Yes when asked "Do you want to add this layer to the map?" Right click LandCover, and click Remove.

14. a. Union the AvailableLand layer with the e_u_dis layer from Step 12 to make a layer called f_r_e_u_dis using the union procedure shown in previous steps (see Step 6).

Try the following query to select available land that is not environmentally sensitive and is within 1 mile of the plant and the major roads leading to the plant.

Selection menu
Select By Attributes
Choose the layer f_r_e_u_dis



"plantin" = 1 AND "in_mjrd" = 1 AND "env" = 0 AND ("Landcover" = 'Cultivated Crops' OR "Landcover" = 'Hay/Pasture' OR "Landcover" = 'Developed, Low Intensity')

b. Remove the e_u_dis and AvailableLand layers.

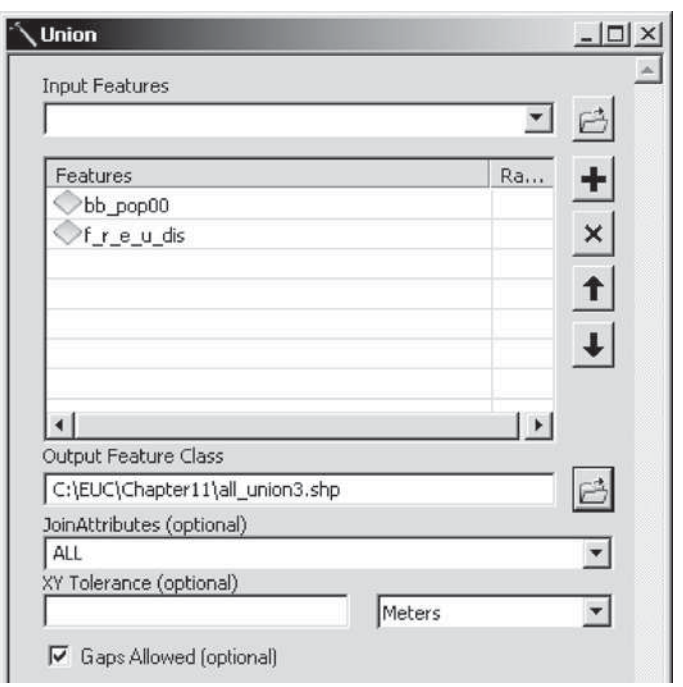
D. Integrate the Census Blocks for the Watershed Area for the Population Analysis

15. From the Selection menu, select Clear Selected Features. Open the attribute table of Bb_pop00.shp. Right-click the pop field, and click Statistics.

Note that the watershed had 36,994 people in 2000 (up from 25,754 people in 1990).

We are now ready to union the census blocks layer with f_r_e_u_dis; however, the resulting layer will include census blocks that have been split into multiple blocks. In addition, the new attribute containing population will include multiple records, and population will be grossly overcounted. We correct for this overcounting by multiplying population in the final layer by the new area divided by the original area. This treats the blocks as though population is evenly distributed throughout the original block, an assumption we know is not true, but is necessary to make.

16. a. Union the bb_pop00.shp layer with f_r_e_u_dis.shp to make an all_union3.shp layer.



b. Remove f_r_e_u_dis.shp and bb_pop00.shp.

Right click the pop field of all_union3 and click Statistics, which will show an exaggeration of the total population (over 300,000, while the original was 36,994).

E. Add Fields and Calculate Values

17. Open the attribute table of all_union3.

a. Click Table Options.

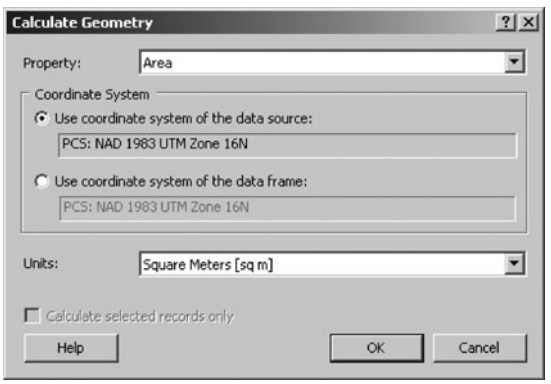
b. Click Add Field.

c. The new field name is new_area, the type is float, Precision is 16, and the scale is 5.

d. Right-click the column name.

e. Select Calculate Geometry from the shortcut menu, and answer yes to edit outside an edit session.

f. Click OK to calculate area in square meters.



g. Click Table Options again, and add the following additional fields (as float and Precision of 16):

Set name to final_pop with a scale of 4.
Set name to plant_rate with a scale of 2.
Set name to road_rate with a scale of 2.
Set name to ag_rate with a scale of 2.
Set name to res_rate with a scale of 2.
Set name to env_rate with a scale of 2.
Set name to grow_rate with a scale of 2.
Set name to pop2020 with a scale of 4.
Set name to pop2020_p with a scale of 4.
Set name to pctchg_p with a scale of 2.

18. Click Table Options and Select By Attributes, and enter 'orig_area > 0.' This is necessary because in the next step we will be dividing by orig_area and there must be no zero values.

19. Right-click the final_pop field to calculate using the following equation:

[pop]*([new_area]/[orig_area])

This is used to correct the error from the splitting of the census blocks.

Right click final_pop and click Statistics; the value should be close to the original population.

20. Keep the table open, click Table Options, and use the following procedure to calculate the growth rate by the plant.

a. Click Clear Selection.

b. Click Table Options.

c. Click Select By Attributes.

d. 'plantin' = 1

e. Click Apply.

f. Click the Show selected records button on the bottom of the attribute table.

g. Right-click plant_rate.

h. Select Field Calculator from the dropdown menu.

i. Enter 1.2 in the large box (the growth rate for the plant area).

j. Click OK.

k. Clear the selection by clicking the Show All Records button on the bottom of the table and then Table Options, Clear Selection.

21. Click Table Options, and use the procedure shown in Step 20, but query in_majrd for "1", and calculate road_rate = 1.0.

Do not forget to click the Show All Records button, Table Options, and Clear Selection after each rate calculation.

22. Use the procedure shown in Step 20, but query "Landcover" = 'Cultivated Crops' OR "Landcover" = 'Hay/Pasture', and calculate ag_rate = 0.8.

23. Use the procedure shown in Step 20, but query "Landcover" = 'Developed, Low Intensity', and calculate res_rate = 0.2.

24. Use the procedure shown in Step 20, query env for "1", and calculate env_rate = −1.2.

25. Calculate Grow_rate = 1.64 + ag_rate + env_rate + plant_rate + res_rate + road_rate. Select the fields from the fields list. Don't type them in.

26. Calculate Pop2020 = 1.64*final_pop. Select final_pop from the Fields list, rather than typing it in.

A field statistics on this field will show the population in the year 2020 without the new communications plant (60,670).

27. Calculate Pop 2020_p = final_pop*grow_rate.

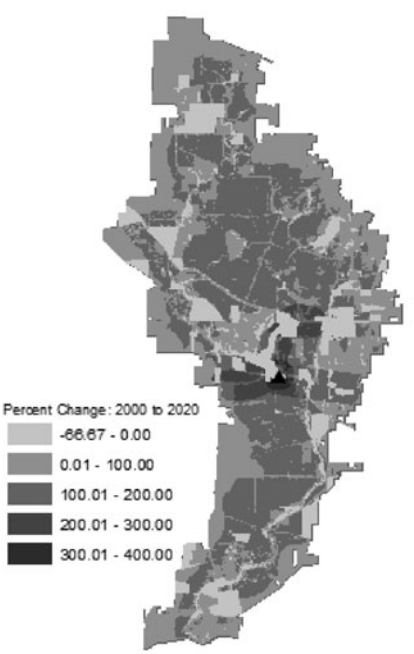
Right click Pop2020_p and select Statistics; the results will show the population in the year 2020 with the new communications plant (72,806).

28. Select final_pop greater than 0 with Select By Attributes.

Do not clear selection.

29. Calculate Pctchg_p = ((pop2020_p − final_pop)/final_pop)*100.

30. Clear selected features and create a graduated color map using pctchg_p as the value of all_union3. *Note:* This will show the population change as a result of the new plant to the year 2020.



F. Examine the Aerial View of the Plant Area

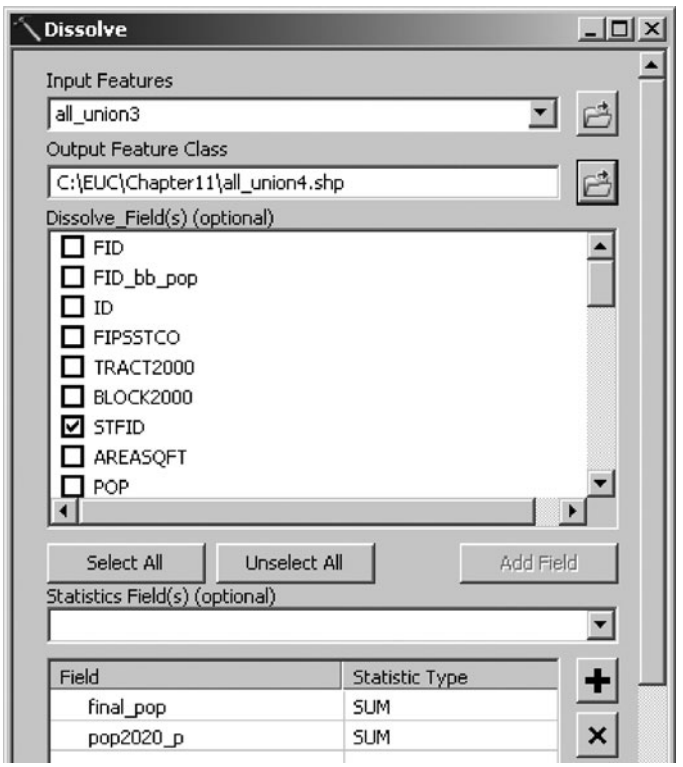
31. Click the Add Data button.

32. Select PlantAerial.img, and then click Add. Or add an aerial from ArcGIS online.

33. If you wish to see the details of the layers below the aerial photograph, right-click PlantAerial.img, select Properties, click the Display tab, change Transparent to 40%, click Apply, and click OK. Move PlantAerial.img to the top of the layer window.

G. A Challenge Step: Reaggregate Model Results Back Up to the Block Level

34. Dissolve all_union3 by the Stfid attribute, aggregate the sum of final_pop and the sum of pop2020_p, and name the result all_union4.



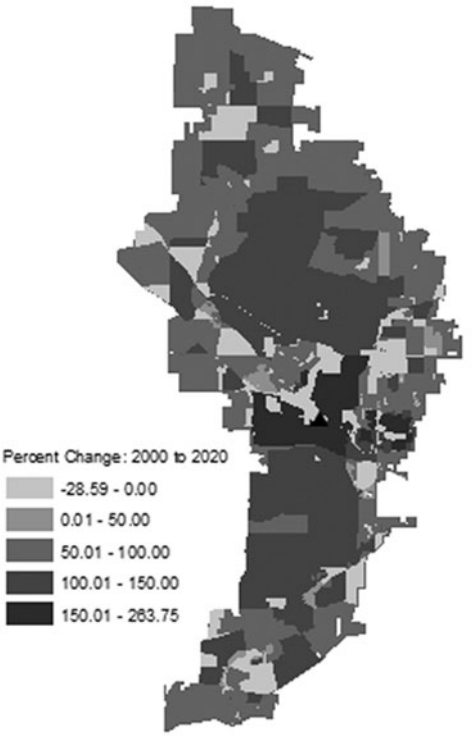
35. Add a field to all_union4 called pctchg_p (type Float, precision 16, scale 2).

36. Click Select by Attributes and enter the following query: sum_final_ > 0.

37. We selected these polygons because you can't divide by zero in the next step.

38. Calculate pctchg_p to equal (([SUM_pop202]−[SUM_final_])/[SUM_final_])*100.

39. Create a graduated color map using pctchg_p of all_union4. *Note:* This will show the population change aggregated to the blocks.



ArcGIS Essay/Report: Write a report discussing the strengths and weaknesses of the above model. Do you consider the spatial procedures appropriate, or would you have changed them? If allotted more time, how would you have improved the model? What other maps would have been helpful to produce for planning purposes? How could the model builder application within ArcGIS help with the testing of alternative scenarios? The final report should be in a standard research format that includes an introduction, a description of your study area (exploratory), research methods, an analysis and discussion of findings, and conclusions. Your conclusion should also address the land-use planning implications of your analysis.

Log in to www.mygeoscienceplace.com for ArcGIS Exercise data files, Google Earth™ Exercise kmz files, RSS feeds, flashcards, web links, and self-study quizzes to enhance your study of urban and regional planning.

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